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Volume 27 JULY, 1921 Number 11

MACHINERY

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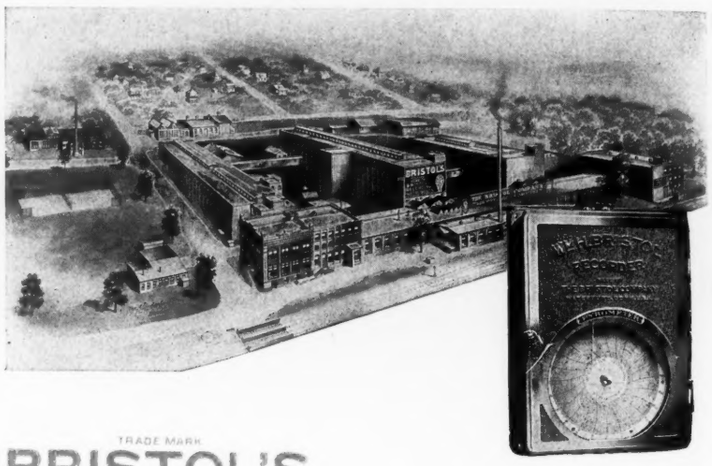

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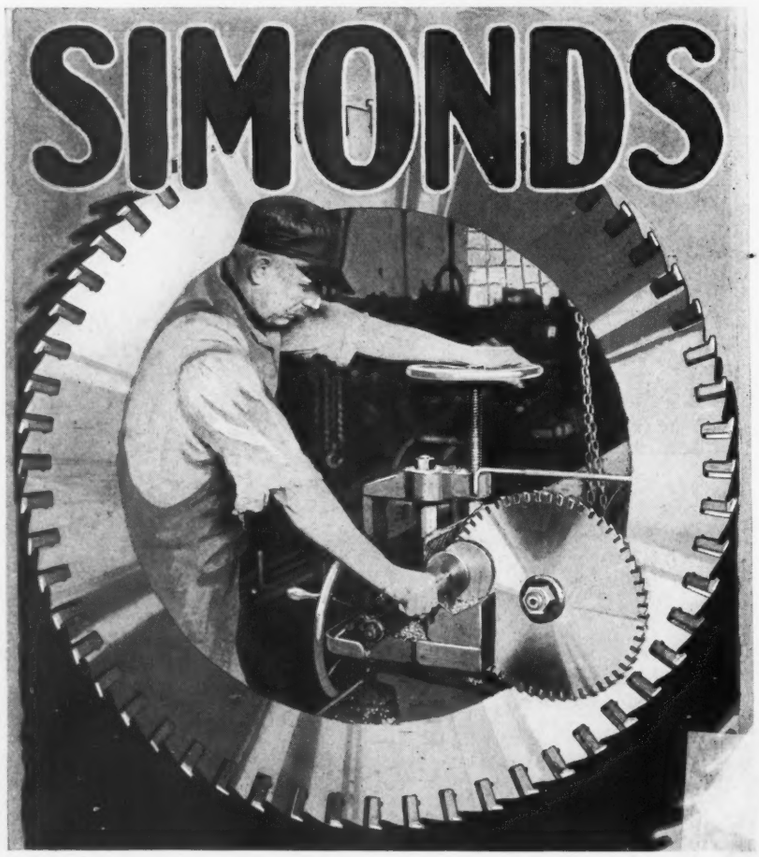

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VOLUME 27 **MACHINERY** NUMBER 11

JULY, 1921

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CONTENTS OF THIS NUMBER

DESIGN AND MANUFACTURE OF NON-METALLIC GEARS ..... *Fred R. Daniels* 1005
INDUSTRIAL CONDITIONS IN FRANCE 1011
THE PROBLEM OF ACCURATE THREAD CUTTING ..... *B. M. W. Hanson* 1012
RAILWAY MACHINE SHOP PRACTICE 1015
COLD-SWAGING 1018
EDITORIALS 1022
What is Normal Business?—Free Service for "Second-hands"—Standardization of Machine Tool Parts—A Severe Experience Forgotten
THE PRESENT SITUATION AND THE OUTLOOK 1023
THE ODONTOMETER FOR TESTING GEAR TEETH ..... *Earle Buckingham* 1029
THE DELCO INSPECTION SYSTEM ..... *Erik Oberg* 1032
GRAPHICAL DETERMINATION OF SHAFT DIAMETERS ..... *N. Barnes Hunt* 1036
PORTABLE ELECTRIC RIVET-HEATER 1038
DROP-FORGE PLANT LAY-OUT AND EQUIPMENT 1039
COMMON CAUSES OF ERRORS IN MACHINE DESIGN ..... *R. H. McMinn* 1045
SOME PRODUCTS OF A MODERN TOOL-ROOM ..... *Charles O. Herb* 1048
RESULTS OBTAINED WITH CRANK-DRIVEN PLANERS ..... *Edward K. Hammond* 1052
LETTERS ON PRACTICAL SUBJECTS 1057
SHOP AND DRAFTING-ROOM KINKS 1063
THE BRITISH MACHINE TOOL INDUSTRY 1064
NEW MACHINERY AND TOOLS 1065

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FOREIGN MACHINERY MERCHANTS PAGES, 322-323 ADVERTISERS INDEX, 351-352 PRODUCT INDEX, 324-348

The Editor's Monthly Talk

THE wide diffusion of mechanical knowledge through the technical press has done more to facilitate the rapid industrial progress of the past half century than any other single factor. Advances in design and practice made in a shop in one part of the country may be known a thousand miles away within a few weeks; whereas, a century ago, years passed before a definite knowledge of developments in New England shops got as far as Philadelphia. In those days there was no technical press, and information was transmitted by word of mouth when mechanics moved from shop to shop and place to place.

This is what gives the serious mechanical journal so keen a sense of responsibility in its chosen field. It must gather its information from all over the world, and must effectively circulate it again to all quarters of the globe. Take July MACHINERY, for example. This number will contain the usual broad range of mechanical articles and industrial and trade news—not counting the smaller news items such as Personals and Trade Notes, etc.—collected from 38 cities and towns in the United States in addition to letters from MACHINERY'S correspondents in London, Paris, and Amsterdam; and July MACHINERY—like all other numbers of the journal—will go to 46 different countries in the New and Old World outside of the United States—Alaska, Argentine Republic, Australia, Belgium, Brazil, Bulgaria, Canada, Canal Zone, Chili, China, Cuba, Czecho-Slovakia, Denmark, Dutch East Indies, England, Finland, France, Germany, Greece, Hawaii, Holland, Hungary, India, Italy, Java, Japan, Mexico, New Zealand, Norway, Peru, Philippine Islands, Poland, Portugal, Portuguese East Africa, Roumania, Russia, Scotland, Serbia, Spain, Sweden, Switzerland, Syria, Turkey, Union of South Africa, Uruguay, and West Indies.

Non-metallic Gearing

In the early days of engineering the only non-metallic material for gears was wood, but wooden gears have now passed out of existence, except in a few isolated instances where wooden teeth are still used in large bevel gear transmissions between an old-fashioned water-wheel and the main shaft. The non-metallic gears now used have either animal hides or cotton for their base material, and are known either as rawhide gears or as fabric-base material gears.

Much has been published about the methods for producing metal gears, but very little relating to non-metallic gearing. The leading article in July MACHINERY takes up this subject and deals comprehensively with both the design and manufacture of rawhide and fabric-base material gears. All the data for this article were gathered right in the shops where the gears are designed and made, and all the statements are backed by the experience and responsibility of a well-known manufacturer.

There has been a need for a simple self-contained instrument for testing the accuracy of gear tooth profiles and the spacing of teeth. The odontometer, described in July MACHINERY, was designed to meet this need, and is equally applicable to spur and bevel gears and can be applied to a gear in place on the machine.

The Crank-driven Planer

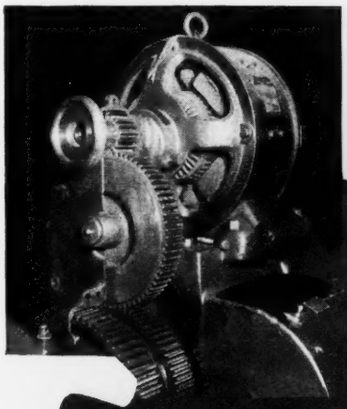
The so-called "crank-planer" has proved its value in many shops for work that comes within its range. It is capable of producing both a satisfactory quality and a sufficient rate of output to make a respected place for itself in the machine tool field. The crank drive affords positive control of the stroke, and the stroke is easily adjusted for different classes of work. The article in July MACHINERY "Results Obtained with Crank-driven Planers" deals with a number of operations performed on machines of this type in half a dozen different plants throughout the country, and shows its application to tractor engine work, machine forgings, railway work, and machine tool parts. This article is another addition to the series on modern planer practice, the publication of which began in January MACHINERY, and has covered various phases of the entire field for which different types of planers are employed.

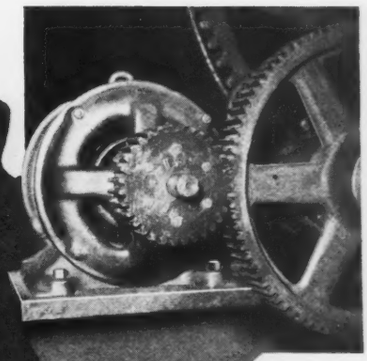
The August Number of MACHINERY

In August MACHINERY will be presented a great variety of articles, some on subjects seldom dealt with in the technical press. One of these—"Automatic Machines in a Watch Factory"—is the first of three articles describing the "almost human" machines employed in the making of the world-famous Waltham watch. Another article will deal with the design and manufacture of drop-forging dies, a subject of definite value and real interest to mechanical men at a time when drop-forging is being employed to an ever-increasing extent.

In the series on the planer class of machines, the August article will deal with production work done on slotters, covering this subject in the same complete manner that the operations on planers have been dealt with in preceding numbers.

For the man who has to do with the organization of a shop and the methods whereby records and systems are kept, there will be articles dealing with the records of materials used in machine construction and on the organization of a large contract plant. The tool designer will find an unusual collection of inspection gages and fixtures in the fourth article dealing with the inspection system of the Dayton Engineering Laboratories Co.; and the article on "Instructions for the Design of Fixtures" will interest him because it contains specific rules and advice relating to his work.





Design and Manufacture of Non-Metallic Gears

Characteristics of Gears Made from Rawhide and Fabric-base Materials—Methods Employed by the Van Dorn & Dutton Co., Cleveland, Ohio, in the Manufacture of Non-metallic Gears

By FRED R. DANIELS

VARIOUS materials are used in the construction of non-metallic gears, but in the practice of the Van Dorn & Dutton Co., Cleveland, Ohio, whose methods of manufacture are here described, the materials mainly used are rawhide and micarta. The present article, therefore, deals specifically with the design and manufacture of gears made from these materials.

Preparation of Rawhide and Fabric-base Gear Materials

The raw material from which rawhide gears are made is the green packer hides, cured and treated by processes that leave mainly a fibrous structure. These processes reduce each hide to a thickness of approximately 1/16 inch, the hide being then blanked into circular disks, the outside diameter of which varies from 2 to 40 inches, or into rings or segments according to the requirements of the gear manufacturer. These blanked-out hides are then dipped into a vat of special-quality glue and assembled between steel end-blocks until a thickness of about 8 or 10 inches has been reached. Hydraulic pressure is next applied to squeeze out the surplus glue, after which the blank is kept compressed until dry, which may require several days. The pressure is increased as the drying process progresses, by drawing up the nuts on the bolts passing through the end-blocks which are employed to hold the blanks together.

Gears made from various fabric-base materials closely resemble each other in physical characteristics. One of these gear materials is manufactured under the trade name of "Bakelite Micarta" by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., and another under the trade name of "Condensite-Celeron" is manufactured by the Diamond State Fiber Co. of Bridgeport, Pa. Both materials are manufactured from fabric of even weave and thickness, which is first impregnated with compositions (condensation products of formaldehyde and phenol) after which a number of the blanks are bonded together under great pressure and the application of heat. These materials are furnished either in large sheets or boards, up to 36 inches square and 2 inches thick, or in such forms as the gear manufacturer may specify, by cutting rings or segments from the impregnated fabric and placing them in a suitable mold before the pressure and heat are applied. The rings or segments are used in special designs where a spider or bushing is the main support, such construction being employed where the stress on the key is likely to be greater than the material itself would be able to withstand if the gear were made of one solid blank. Micarta is frequently molded on a hub center in such a manner that no additional mechanical retaining means are required. This type is most commonly used in timing gears. A few of the many and varied designs, which have been successfully applied to service will be referred to later. The rawhide gear blanks before being machined and the sheets of impregnated gear material as they appear when received from the manufacturer are shown in Fig. 1.

Non-metallic gears are used primarily where quietness of operation at high speed is the first consideration. Rawhide was the earliest material used for this class of gearing; later numerous other materials such as micarta, condensite, formica, fabrico, fabroil, and Egyptian fiber were introduced. These materials are more economical than rawhide, and are used by many gear manufacturers when the gears are not subjected to severe stresses. The present article deals with the practice of the Van Dorn & Dutton Co., in the manufacture of non-metallic gears.

Physical Characteristics and Strength of Rawhide

Rawhide gears should not be subjected to a higher temperature than 225 degrees F., as otherwise the material will become dried out and permanently injured, because dried out rawhide cannot be revived. Furthermore, the gear blanks

must not become wet, as moisture destroys the bonding material, and the blanks become distorted when again dry. Hence, much care must be taken to provide suitable storage space for rawhide gears, so that they are not exposed either to too much heat or to moisture. When not in use, the rawhide should be coated with shellac and kept in a cool dry place. The life of the gear is greatly prolonged, in service, by the use of a lubricant consisting of a thin mixture of lard oil and graphite. This lubricant covers the face of the gear teeth with a thin metallic film which protects the rawhide. Mineral oils should never be used as a lubricant for rawhide.

In considering the strength of any gear material, the velocities at which the gears operate must be taken into consideration. Although rawhide is not as durable as steel, it is often used for gears having peripheral speeds of from 1700 to 2000 feet per minute or more. The material is as strong as cast iron at high speeds, although weaker when subjected to a static test. The life of gears made from rawhide is greatly prolonged by virtue of the cushioning effect of the rawhide gear teeth operating in mesh with a metallic gear. Rawhide is a successful competitor of bronze from the viewpoint of ultimate cost, owing to its comparative length of service, but is somewhat higher as regards first cost. Rawhide loses its flexibility when subjected to continual bending, and should never be used with cast tooth gears. The inaccuracy of the cast tooth outline and spacing produces a destructive strain on the teeth of the pinion.

A safe working load for rawhide pinions is 150 pounds per inch width of face for gears of one inch circular pitch. The working load for other pitches should be in proportion, but should never exceed 250 pounds per inch of face width. An allowance of from 20 to 25 per cent should be made for overload, sudden impact, and varying working conditions. This statement relative to strength applies only to pinions constructed without flanges. When the pinions are provided with flanges, usually made of bronze and cut to form a part of the working face of the teeth, the strength values may be increased from 10 to 25 per cent.

Fig. 1. Raw Material in the Form of Rough Laminated Rawhide Blanks and Large Sheets of Bakelite

Physical Characteristics and Strength of Fabric-base Materials

For silent operation, fabric-base materials are undoubtedly superior to rawhide. They are self-supporting and rarely, if ever, require the use of shrouds to maintain the shape of the teeth. They are not affected by water or oil in a destructive sense and, on an average, absorb only about 1½ per cent of moisture in a period of fifty hours. These gear materials are not attacked by rodents, and are not susceptible to the action of acids or alkaline solutions. They are easily machined, will take a high finish, and consequently present a smooth working face which wears well and furnishes even tooth contact. The fact that a material is self-supporting makes it possible to obtain a greater factor of safety for gears made from it, which are to be keyed to the shaft. In some cases end plates are used, but these are in special designs only, as will be described later. The length of service obtained from gears made of fabric-base materials is claimed to be superior to that of cast iron or brass. These materials do not shrink at temperatures under 200 degrees F.

The specific gravity of these fabric-base materials is 1.4, the weight 0.05 pound per cubic inch, and the Brinell hardness, from 30 to 40. The raw material has a tensile strength, parallel to the laminations, of 10,000 pounds per square inch; a compressive strength of from 35,000 to 47,000 pounds per square inch perpendicular to the laminations, and from 17,000 to 24,500 pounds per square inch parallel to the laminations; and a transverse strength, both parallel and perpendicular, of 17,000 pounds per square inch. In figuring the strength of gear teeth by the Lewis formula, however, a safe working load greater than 5000 pounds per square inch should not be used.

The diametral pitch of gear teeth recommended for service is as follows: For smaller loads up to and including ½ horsepower, 10 pitch; for 1 horsepower, 8 pitch; 2 horse-

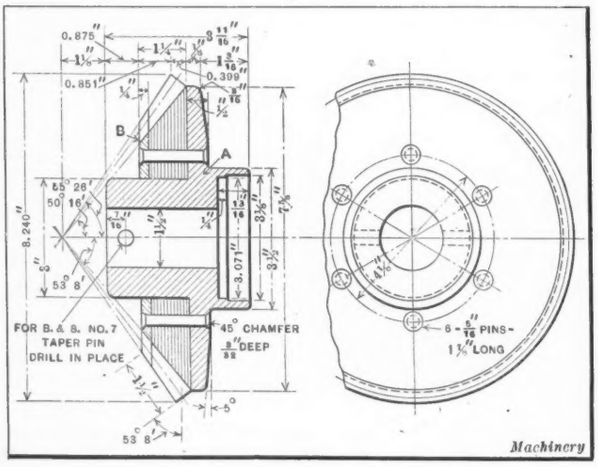


Fig. 2. Rawhide Bevel Gear with Cast-iron Center and Brass Side Plate

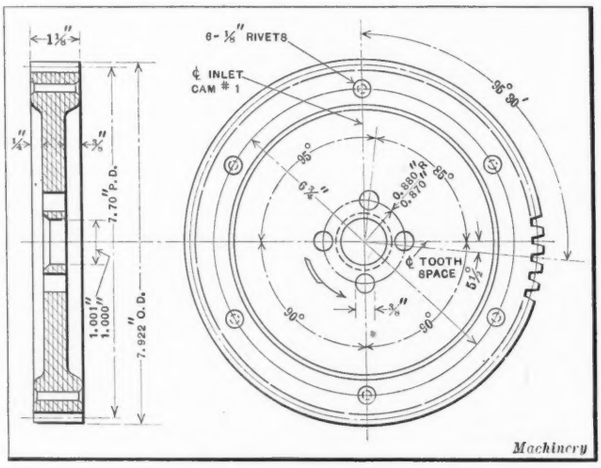


Fig. 3. Camshaft Spiral Gear made from Blank cut from Solid Stock

power, 5 pitch; 10 horsepower, 4 pitch; 15 horsepower, 2 pitch; 25 horsepower, 2½ pitch; 50 horsepower, 2 pitch; 75 horsepower, 1¾ pitch; and 100 horsepower, 1½ pitch. When heavier service than 100 horsepower is encountered, the design of the gears should receive special consideration. The maximum recommended pitch line speed is 2500 feet per minute. The greatest length of service for gearing is obtained when there is a good rolling contact; consequently, the most desirable condition in non-metallic gear design is where there is a comparatively large number of teeth. Gears having less than fifteen teeth do not furnish good rolling contact, and they wear faster and vibrate more than when a finer pitch tooth is used. It may even be good engineering to redesign the entire gear train in order to use gears of smaller pitch.

Design of Rawhide Gears

Gears and pinions made of rawhide are generally furnished with side plates or shrouds made of bronze or brass, with the teeth cut through them. These support the material and add considerably to its strength. Such a design applied to the construction of a bevel gear is illustrated in Fig. 2, in which the cast-iron spider *A* has a large flange that supports the rawhide on one side, and a side plate *B* on the opposite side, assembled by six pins. Another construction in which the sides of the gear teeth are not supported is shown in Fig. 8. The cast-iron spider *A* is suitably flanged to support the rim of rawhide in which the teeth are cut. These two gears will be recognized in the collection shown in Fig. 6.

In the application of rawhide gears it is generally practicable to make the pinion of rawhide. The number of teeth should, if possible, be about 15 or 18. It is necessary to construct only one gear in a pair from rawhide in order to obtain the desired quietness of operation. On account of the high cost of rawhide, the smaller member is the one usually so constructed. Shrouded pinions of the design in which the flanges reach to the top of the teeth are not to be recommended from the manufacturing point of view. This construction involves extra machining.

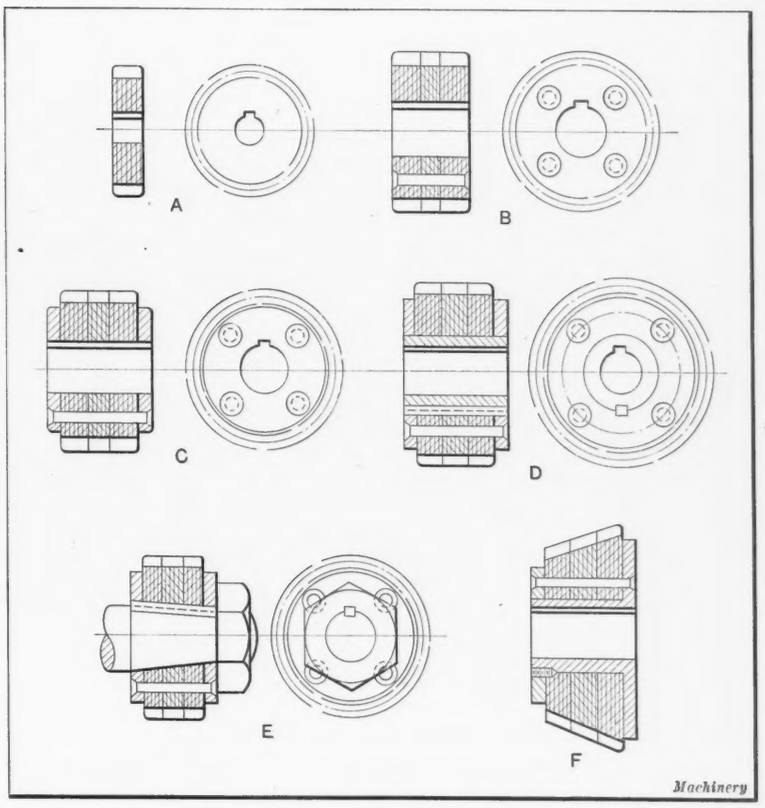


Fig. 4. Different Designs of Micarta Gears

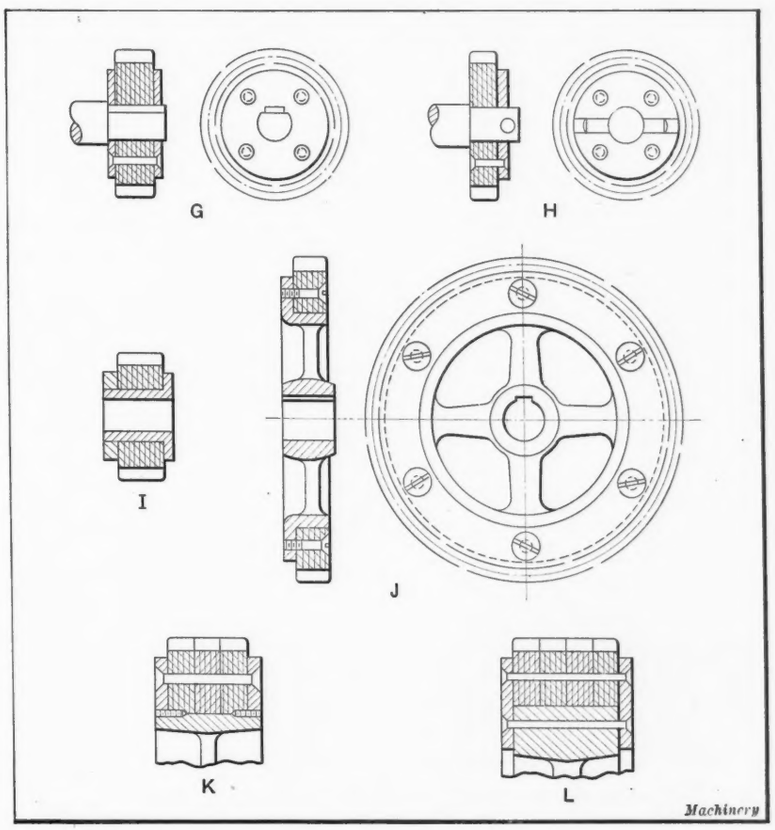


Fig. 5. Other Micarta Gears of Special Construction

Large pinions are usually designed with a cast-iron spider or central bushing which is a means of reducing the cost and increasing the strength, particularly at the hub where shear is encountered owing to the use of keys or set-screws for attaching the gear to the shaft, but this construction is not recommended when directly applied to severe intermittent motions. Excessive wear is often caused by insufficient consideration being given to the machine supports, and by unsuitable bearings, either of which will result in misalignment of the meshing teeth. Under proper working conditions, however, the service furnished by rawhide gearing has been generally satisfactory. Rawhide has been successfully employed for both spur and bevel gears, but not generally for other types.

Design of Fabric-base Material Gears

Gears made from fabric-base materials are cut from solid blanks for sizes under 6 inches in diameter; larger sizes are made either solid or by setting rings on metal spiders and attaching them by the use of rivets or bolts. Shrouds are rarely required, except where the service is unusually severe or where the diameter of the gear is more than four times the width of face.

Figs. 4 and 5 show a number of designs commonly used in the construction of micarta gears. The style shown at *A* is for light service, where not more than five horsepower is to be transmitted. This design may be provided with either a straight or a tapered hole as required. The maximum width of face is 2 inches, pitch diameter not over 8 inches, and the root diameter not less than twice the shaft diameter. The style shown at *B* is for transmitting not more than fifteen horsepower, where the speed and torque are constant. The blank is constructed of layers, which is a common practice where the width of face makes it necessary, and these layers are assembled by round or flat-head rivets, using washers if the space between the bore and the root of the teeth permits. The number of rivets required is usually four, although this may vary. The diameter at the bottom of the teeth should not be less than two and a half times that of the shaft.

The design shown at *C* employs side plates to furnish additional strength at the keyway; it is intended for heavy duty, and may be used where the service is intermittent. Rivets and washers are used, the same as in style *B*. The design shown at *D* makes provision for easy replacement. The end plates are attached to a cast-iron bushing by means of a key, the rivets locking the entire arrangement together and enabling the bushing to be easily removed when the keyway, by means of which it is keyed to the shaft, becomes worn.

The construction commonly used for tapered shafts is shown at *E*, while for bevel pinions, style *F* may be used. This design may be constructed either with or without a central bushing; the illustration shows a gear with a central bushing, and it will be seen that it is provided with a wide flange for withstanding the axial thrust at the large end of the gear. As in the other designs, rivets are used in the assembly, and washers, if the space permits. The designs shown in Fig. 5 are all of a special nature. Styles *G* and *H* are the constructions often used when the pinion is attached to a shaft extension. Style *H* may be employed when it is not convenient to use a key, the drive being by means of a pin engaging the end plate. In both these designs, rivets or screws may be used in the assembly. For drives in one direction, the shaft extension may be threaded and the pinion shrunk on a washer. The end of this washer should have a diametral slot in which the lugs of a special flanged nut may fit to drive in the direction of the hand of the thread. This construction is used when the distance between the root of the teeth and the bore will not permit the use of a key.

At *I* a knurled flanged cast-iron bushing is used as a center for the micarta. The exterior of the bushing has a tendency to prevent the material from turning on the bushing. The parts may be fastened together in any desirable way. Style *J* employs a flanged cast-iron spider, and this construction is used for gears from 6 inches to 1 foot in pitch diameter. The maximum width of face for gears of this construction is 2 inches. The flange may be attached either by screws or rivets. This design is sometimes made by molding the gear material on a spider, the outside diameter of which is knurled, and which has no flange. A coarse diamond knurl is utilized in machining the outside of the spider. The customary screws and rivets are used in gears of this type. Whether or not it is advisable to follow this construction depends largely on the quantity involved and the expense of making a mold and a pattern. If the width of face is more than 2 inches, two flanges should be used. The constructions shown at *K* and *L* are for large gears and enable replacements to be readily made. The non-metallic rims are shrunk on the cast-iron spider and the flanges fastened by screws or rivets in the manner indicated. The quantity of rivets required varies with the size of the gear and the service to which it is to be subjected.

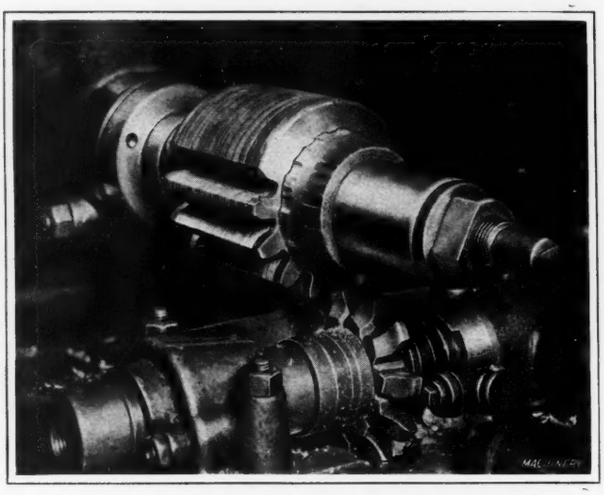


Fig. 7. Gear-cutter Set-up for cutting the Teeth in a Flanged Rawhide Pinion

More than one thickness of micarta is required when the width of face exceeds 2 inches, and care should be taken to have the outside pieces at least ¾ inch thick. The end plates may be made either of cast iron, steel, or bronze. The thickness of plates for gears 2 inches in diameter is ⅛ inch; for gears 3½ inches in diameter, 3/16 inch; 8 inches in diameter, ¼ inch; 10 inches in diameter, 5/16 inch; and for gears over 10 inches in diameter, ⅜ inch. The outside diameter of the end plates need not necessarily be more than 2 inches greater than the diameter of the circle on which the rivets are located. End plates should not extend beyond the root of the teeth. Solid pinions may be shrunk on the shaft or spider by heating them to approximately 200 degrees F., or if the bore is 2 inches or more in diameter, by immersing in boiling water before assembly. An allowance for shrinkage of 0.001 inch per inch of bore diameter should be made. The face of the pinion should not be greater than that of the mating gear.

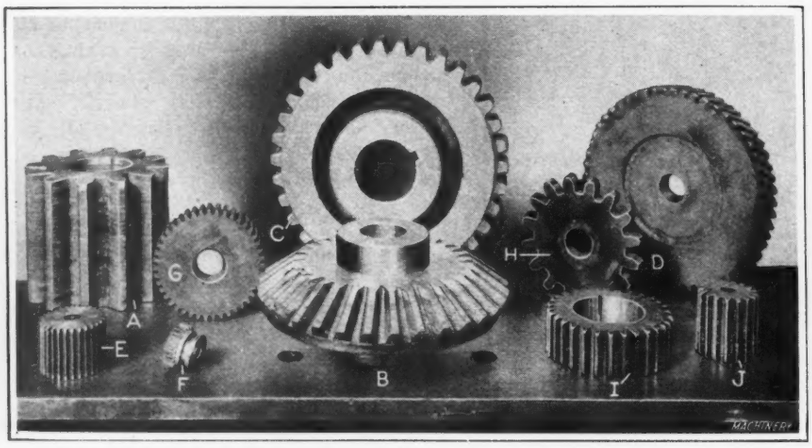


Fig. 6. Collection of Rawhide and Micarta Gears

Machining Rawhide Gear Blanks

The rawhide blanks, such as are shown on the shelves in Fig. 1, are first split into the width of face required for the gear, after which the metal flanges, if these are used, are bolted on through holes previously drilled in the blanks. The gear blanks are then turned to the proper outside diameter, which is done in an ordinary lathe, using similar turning tools to those used in metal working. The speeds and feeds of the lathe should be about double those used for turning cast-iron gear blanks. In cutting the gear teeth, the process is

exactly the same as in cutting metal gears, so far as machines and methods are concerned, but it has not been found advisable to use a standard gear-cutter when machining this material. The gashes between the teeth become clogged with the soggy, glue-laden chips so that it has been found good practice to use a worn cutter, ground with an abundance of chip space, or even one in which some of the teeth are broken out. The speeds and feeds are faster than on cast iron in about the same proportion as for turning.

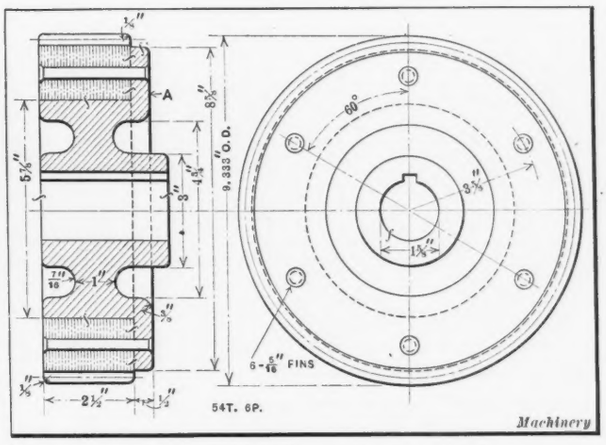


Fig. 8. Spur Gear with Cast-iron Flanged Hub on which a Ring of Rawhide is shrunk and fastened

The gear shown at *A*, Fig. 6, has fourteen teeth, 3 diametral pitch, flanged at both ends, and has a face width of 4½ inches. The teeth are cut on a Newark gear-cutting machine, the set-up being shown in Fig. 7. Attention is called to the previous reference to excessive chip clearance which may be plainly seen in this illustration. The cutter speed used in performing this operation is 110 revolutions per minute, and the feed 8 to 10 inches per minute. The production time is thirty-five minutes per gear.

The bevel gear *B*, Fig. 6, has thirty-two stub teeth, 4/5 diametral pitch, and a face width of 1½ inches; the detailed dimensions of this gear are shown in Fig. 2. The teeth are cut on an 18-inch Gleason bevel gear planer set up as shown in Fig. 9. The cutting speed is 127 strokes per minute, and the feed used, 56 seconds per stroke. The time required to cut the teeth is two hours per gear, both for gashing and for finish-planing.

Of the other rawhide gears included in the collection shown in Fig. 6, gear *C* is shown in detail in Fig. 8. This is a motor pinion and has fifty-four teeth, 6 diametral pitch, and a pitch diameter of about 8 15/16 inches. The other gears shown in this collection are various designs of micarta gears and pinions.

Machining Fabric-base Material Gears

The plates from which fabric gears are cut, together with some of the rough blanks, are shown in Fig. 1. In cutting out the blanks, the material may be sawed, or a trepanning tool such as is shown in Fig. 12 may be employed. The operation is performed on a drilling machine in the manner indicated in Fig. 11. This method of cutting out the blanks is preferable to the use of a band saw in that a more accurate blank can be obtained. The shank of this tool has a regular standard spindle taper, and is hardened and ground; the cold-rolled steel pilot, which is also hardened and ground, centers the tool in a hole drilled to accommodate it. The cutters have hardened and ground tool-steel cutting edges and soft shanks, and are designed so that one will cut on the outer circumference of the groove, and the other on the inner circumference. The design of the cutters is also shown in Fig. 12. By making the tools in this way, the cutting action is balanced and clogging of chips obviated.

It has been found that a 14-inch diameter circular saw having from 110 to 120 teeth, hollow ground, will give a good clean cut, if properly sharpened and operated at 2500 revolutions per minute, or at a surface speed of about 9000 feet per minute. The saw should not be set for clearance, and should be resharpened every fifteen or twenty minutes when in constant use. In general, the sawing of fabric-base materials is similar to the sawing of wood, and the speeds and feeds used are also about the same. The best results for band-sawing will be obtained with a 5½ point saw, 19 gage, running at about 4000 lineal feet per minute, which is equivalent to 425 revolutions per minute with a wheel 36 inches in diameter. The width of band-saw blade may be anywhere from ¼ inch to 1¼ inches as required. A band saw will last from one to two hours, depending on the grade and thickness of the material being cut.

It is good practice to round off the gears at the periphery to a radius of 1/16 inch or less, depending on the pitch of the teeth. If the gear blank is to be supported by plates of the same outside diameter as the gear, during the cutting of the teeth, this rounding of the corners should not be done until after the completion of the gear-cutting operation. For drilling, high rotative speeds should be used; ¼-inch diameter drills and under will stand speeds of from 2500 to 10,000 revolutions per minute, and larger sizes in proportion. It is safe to state that the best results will be

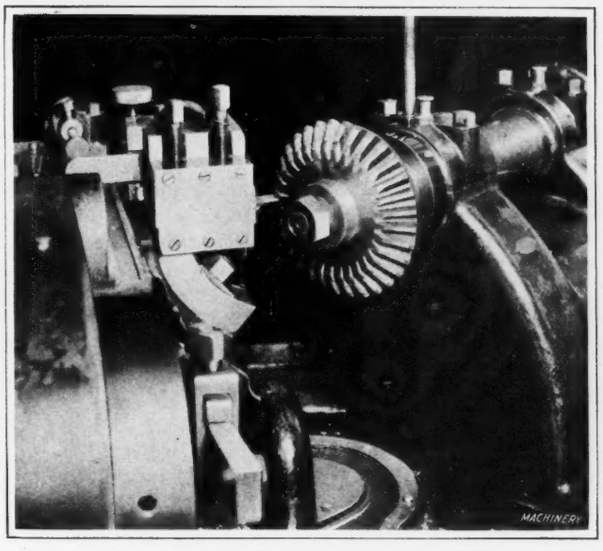


Fig. 9. Gear Planer on which the Teeth in the Bevel Gear shown in Fig. 2 are cut

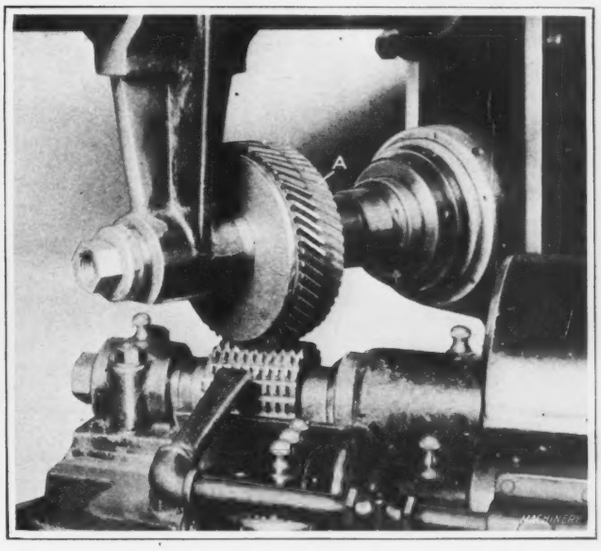


Fig. 10. Using a Backing Plate when hobbing the Teeth of a Spiral Gear

obtained by running the drill at the highest speed that can be used without burning the tool. To prevent excessive heating, the drill should be removed from the hole as quickly as possible after the drilling operation has been finished. Drills should not be forced, and if kept sharp, they will require but slight pressure to feed them through the material. Owing to the resiliency of the material, the expansion that takes place immediately after the hole has been drilled, produces a hole which will be approximately 0.003 inch over size, so that if it is desired to have the hole up to standard, it is necessary to make allowance for this characteristic of the material.

In milling, the cutting angle of the cutter should be ground with a slight front rake amounting to about 3/32 inch on a 3-inch diameter cutter. High speeds and coarse feeds should be used in general, and an effort should be made whenever possible to remove all the material during one cut. In turning fabric-gear blanks, the work should be turned to size whenever possible in one cut, but where two cuts are found desirable, the finishing cut should remove at least ⅛ inch of stock. The material should be turned at a surface speed of from 75 to 100 feet per minute, which is about 25 per cent faster than used on medium grade cast iron. The speed at which the gear blanks are turned will, of course, be governed by the depth of cut taken. A coarser feed than is ordinarily used in turning cast iron should be employed. A wide-nosed tool, without top rake and with plenty of side clearance, will give the best results. Care should be taken to keep the tools sharp, and it will be necessary to regrind the tools frequently, as the turning of this material dulls the cutting edge very quickly. In turning, it is unnecessary to use any lubricant. On account of the resiliency of the material, it is good practice to turn the outside diameter slightly under size to allow for the increase in diameter which occurs at the completion of the cut. It is this characteristic of the material which will give a shrink fit in holes drilled to standard dimensions. For the more accurate surface-finishing operations, grinding is to be preferred. Water should be used in the grinding operation to keep the wheel clean.

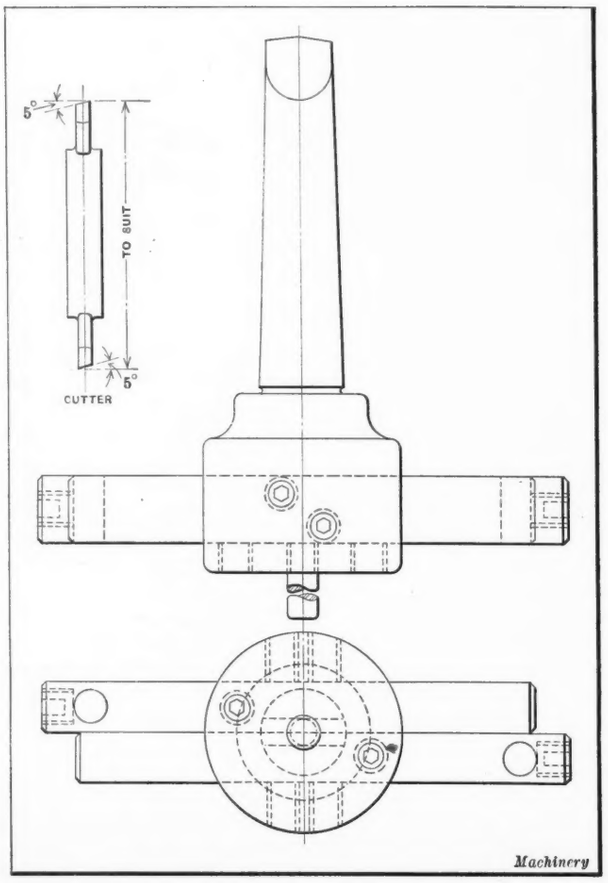


Fig. 12. Trepanning Tool by Means of which the Gear Blanks are cut from Stock

Fig. 11. Cutting the Blanks from Micarta Sheets

The maximum cutting speed permissible for hobbing teeth in micarta gear blanks is 180 surface feet per minute, which is much higher than is permissible on metal gears. The most suitable feed will be from 0.03 to 0.08 inch per revolution of the work, these limits being somewhat lower than ordinarily used for cast-iron gear hobbing.

A gear of similar design to that shown at *D*, Fig. 6, is illustrated in Fig. 3. This is a camshaft gear made of solid micarta cut from a sheet, and has sixty teeth, 9 diametral pitch, with a 15½-degree pressure angle. The teeth are right-hand helical, the angle being 30 degrees 2 minutes, and the lead, 41.8425 inches. The operation of hobbing the teeth is shown in Fig. 10, using a No. 12 Barber-Colman machine with a hob of standard design. The hobs, like the milling cutters used on this and similar material, must be provided with liberal chip clearance, but otherwise the equipment is not special in character. In order to prevent the edges from being frayed, the work is located on the arbor against a back-up plate which may be seen at *A* in the illustration. The feed used on this job was 0.037 inch per revolution and the speed 200 revolutions per minute, which is the highest of which the machine is capable. The hob is 9 diametral pitch, 4 inches outside diameter, and 3½ inches long, so that the speed of 200 revolutions per minute is equivalent to a surface speed of 160 feet per minute, which is much higher than would ordinarily be used for machining cast iron. In general, the tools used in cutting fabric-base materials, such as micarta and condensite, should be kept sharp and have plenty of chip clearance. Gear teeth may be cut in a number of blanks mounted

together on one arbor, which is advantageous in that each adjacent blank serves to back up the one next to it.

Only a few of the many designs of non-metallic gears are shown in Fig. 6, but these should be sufficient to show the general construction, and in some measure, the variety. In addition to the gears already mentioned, there is a double-faced solid micarta gear *E* having a face width of 2 inches, an outside diameter of 1⅞ inches, and a ½-inch bore. Gear *F* is a special steel flanged micarta pinion for an automobile oil-pump. The other four gears *G*, *H*, *I*, and *J* are all made of solid micarta and are of varying designs and sizes.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, June 9

The period of uncertainty in France continues, but there are indications of an urgent need for considerable quantities of various products, and the general feeling is that business will shortly improve appreciably. During the past month an industrial exhibition was held at Paris, and this was attended in great numbers. There were numerous inquiries and many sales were made. All the machine tool manufacturers were represented, and in this section visitors were particularly interested in vertical boring and turning mills and grinding machines. The iron and steel market seems to have become stabilized, as no decreases in prices have occurred for several weeks.

New Process of Manufacturing Steel

A French engineer, Mr. Basset, has invented a furnace for the manufacture of steel, which utilizes pulverized coal for fuel instead of coke. An experimental furnace has been erected and steel produced with excellent results. The outstanding feature of the new process is the economy effected. It is claimed that steel can be made at even lower costs than before the war. A company has been formed with a capitalization of 60,000,000 francs ($4,750,000 present exchange) for the purpose of manufacturing steel by the new process. Most of the large steel manufacturing concerns of France are connected with this firm, including La Ste. Longwy, Les Trefileries du Havre, Saulnes, and Ougree.

New Cotter-pin Machine

The firm Royer, of Paris, has just built a machine for manufacturing cotter-pins. This machine is said to have shown marvelous results, producing cotter-pins at the rate of 25 per second or 90,000 per hour, 8 kilometers (about 5 miles) of wire being required per hour to feed the machine. It has been estimated that four of these machines will be sufficient to supply the entire French market with pins of this type. It is intended to place the machine on sale upon the completion of a plant for producing wire to suit the machine.

Wage Reductions

The cost of living has become noticeably lower, and manufacturers show a tendency to reduce wages in proportion. The large automobile concerns have lowered wages from 15 to 20 per cent, and these reductions have been generally received without protest, due, no doubt, to the fact that many of the firms in this industry are closed down entirely. At La Rochelle and La Pallice the workmen in the iron and steel industries have accepted a reduction of 15 centimes (1.2 cents) per hour. In consideration of the sacrifice made, and because the cost of living in this vicinity has only been reduced to a slight degree, the workmen have asked the authorities to control the prices of foodstuffs, reduce the profits of retail merchants, and allow the publication of prices without charge by dealers who sell their foodstuffs reasonably low.

Continued Idleness of Plants and Workmen

The number of plants closing down has decreased, and there are less idle workmen in Paris than formerly. The latter condition, however, is due to the fact that a great number of idle men have moved from this city. Another cause for less idleness is the calling of the 1919 military conscripts to the colors. This has resulted in many vacancies in plants which have been filled from the idle ranks. Business conditions in the iron and steel industries have not improved, and in some sections the situation is even worse, but, in the clothing and textile industries a slight improvement is apparent. The automobile field also shows some improvement, Renault producing forty cars per day, and Citroen, sixty cars per day. It is believed that the high cost of gasoline is one of the principal reasons for the depression in this industry.

New Companies Formed

Les Etablissements Horstmann, Paris, has just been organized with a capitalization of 5,000,000 francs (approximately $400,000) for the manufacturing, purchasing, and selling of machine tools. Another firm, Les Etablissements Coulaux & Cie, has been capitalized at 4,000,000 francs (approximately $320,000) for the manufacture of steel and tools. This concern is affiliated with Forges et Acieries de Firminy. Les Etablissements Henri Gras has also been capitalized at 1,700,000 francs (about $135,000) for the manufacture of metals, particularly copper, bronze, and aluminum.

La Société d'Outillage Mecanique et d'Usinage d'Artillerie Souma, has obtained from the city of Paris, an order for sweepers, sprinklers, and steam rollers, the total order amounting to 10,000,000 francs ($792,000). This firm has also received an order from La Ste. Industrielle des Transporta Automobiles for 230 automobile truck chassis. The amount of this order is reported to be about 15,000,000 francs ($1,190,000).

* * *

CONDITIONS IN THE SWEDISH IRON AND STEEL INDUSTRIES

The Swedish steel and machinery industries have experienced extreme difficulties during the past year, owing to the general business depression in Europe, the cutting off of the former trade with Russia—which was a large factor in the Swedish export trade in machinery—and the high prices prevailing in the world's markets, which enormously increased the cost of manufacture. The exceedingly high prices of fuel make it difficult for the industry to meet foreign competition. The export trade of Swedish pig iron and steel has also been made much more difficult by the conditions created during the war, when a number of English purchasers of Swedish pig iron and steel were forced to use raw materials obtained from other sources, and it has been found difficult for the Swedish iron and steel industry to regain this former export market.

* * *

MACHINE INDUSTRY IN ARGENTINA

In a recent Commerce Report, it is stated that the machine shops of Argentina are usually well equipped, there being a number that are in a position to take any class of work. They are divided into several large groups, according to whether they handle marine construction, automobile and general repairs, or actually build machinery and parts. The principal articles built are the following: Machinery for meat-packing plants; punch presses and other can-forming machinery; boiling vats and general apparatus for candle- and soap-makers; dairy, bakery, macaroni and oil-mill machinery; and in addition to these, a number of specialties such as wool-washing cisterns, rock crushers, centrifugal pumps, shoe machinery, etc.

The Problem of Accurate Thread Cutting

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

WHEN I entered a machine shop to learn the rudiments of mechanics, one of my first jobs was to tap a number of holes. The tools used for this purpose at that time were of the same kind and as good as they are today. For drilling holes, we had to make our own drills, and it was considered an accomplishment to be able to forge and twist a good drill; after hardening, we had to straighten the tool the best way we could. Drills of that kind are not used nowadays. A drill would not be accepted as a gift unless it is finished to size after hardening, and has the proper relief. But even so, we do not expect a modern drill to drill a hole exactly to size, and we do not expect that the hole will be perfectly straight.

When it is desired to produce an accurate hole, a reamer is made, which is ground and relieved after hardening. A reamer is expected to cut a hole to a predetermined size, and it is not very difficult with modern methods to produce such a reamer. To fit a piece accurately into a reamed hole is rather an easy task, where modern grinding machines are available, and the amount of freedom or tightness of the fit is determined by the size of the piece that enters the hole.

Requirements to Fulfill in Fitting Threaded Parts

When it comes to fitting threaded parts together, we have made very little progress. On large diameter screws, such as those used in machinery for moving slides and other parts where accuracy is required, we still chase the nut in a lathe and cut the thread of the screw either in a lathe or a thread milling machine. The principal reason for this is that exactly the same lead is required in the nut and on the screw, so that the threads on the screw will have contact throughout the length of the nut, thereby affording a good wearing surface and ample strength. If nuts of this kind were tapped, each nut would have the same error as the tap has after hardening, and the screw would only fit on a very small portion of the thread; it would not have a good contact until the threads on the screw and in the nut had become sufficiently worn to make the leads in these two members more uniform with each other.

In tapping holes for ordinary screws, such as those used in holding machine parts together, good fits are chiefly dependent upon the accuracy of the tap. As the tap is generally a rigid tool and non-adjustable, it will tap a hole approximately to its own size; but when the lead has been

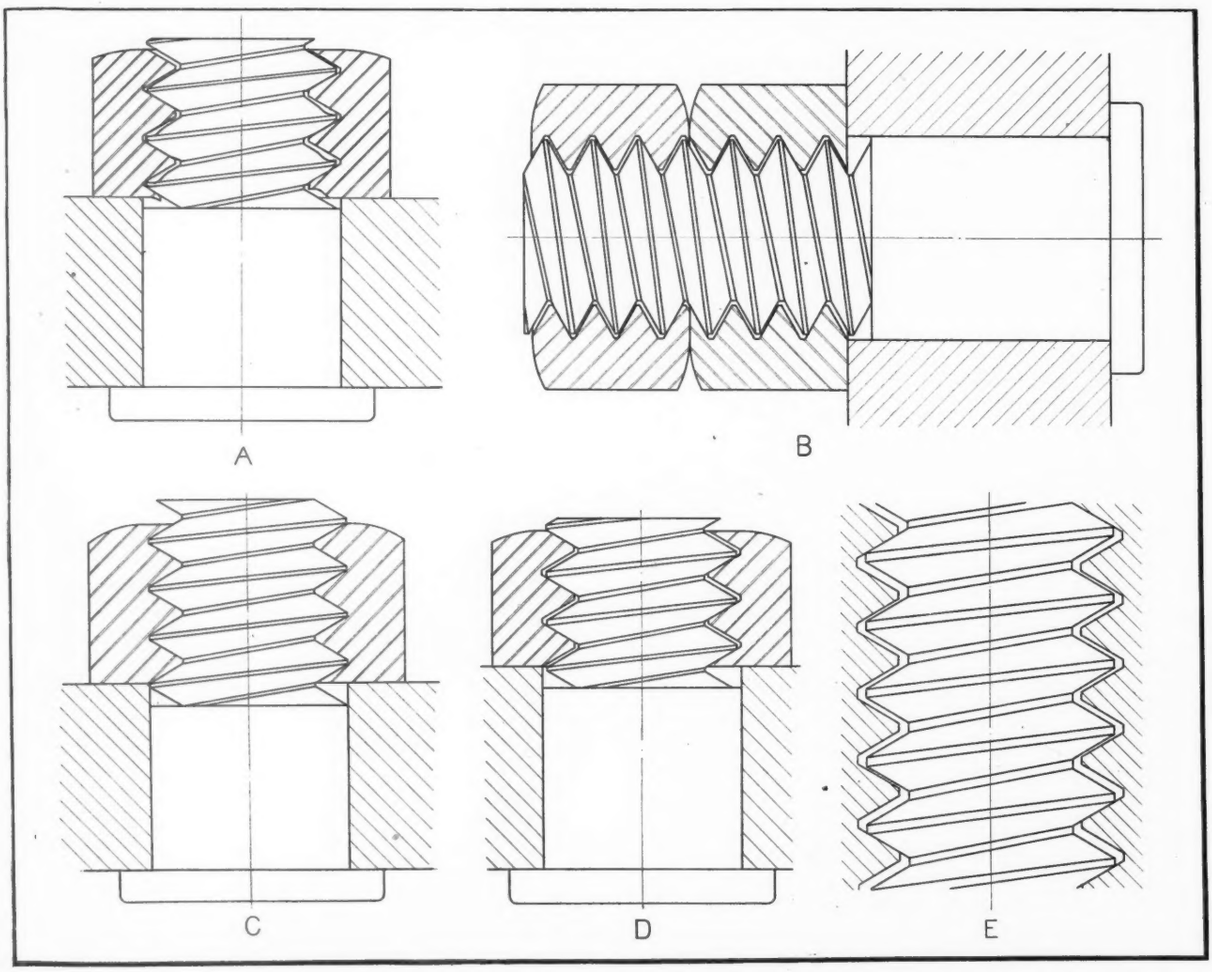


Fig. 1. (A) Distortion of Threads when those of Nut and Screw are not of Same Lead. (B) When Leads of Threads of Nut, Lock-nut, and Screw are Different, only about One Thread has Contact in Each Nut. (C) Ideal Condition of Contact with Correct Lead, Diameters, and Thread Angles. (D) Uniform Contact on Pulling Side of All Threads with Correct Lead in Nut and on Screw, although Screw is a Loose Fit in Nut. (E) Nut of Standard Diameter with Inaccurate Lead, differing from Lead of Screw; Screw must be Under-sized to enter Full Length of Nut

found to be inaccurate, due to distortion in hardening, there has been in the past no practical means of correction to bring the tool back to its original condition of accuracy. Dies used for threading screws are generally adjustable as to diameter, and because their chasers are short, they are easier to control in hardening. For this reason screws with fairly accurate leads can be cut with commercial dies.

Absolute accuracy of the lead in taps is unknown, and even the diameter and shape of thread is very hard to maintain. Tolerances are therefore established on fits between the threaded parts. By the use of such equipment as the Hartness comparator, made by the Jones & Lamson Machine Co., of Springfield, Vt., which was described in MACHINERY for January, 1920, it is a simple matter to determine the accuracy of the leads of threaded parts. The diagrams and illustrations shown in connection with the present article clearly show what happens when the lead in a nut and a screw are not alike.

Lead of the Screw

When the lead in a nut varies from the lead in a screw, as shown at *A* in Fig. 1, there is hardly more than one thread in contact. When the nut is tightened, this one thread yields until one more thread is in contact, and by further tightening, it may be possible to get a number of threads to assist in carrying the load. However, the engagement between the threads of the nut and the screw extends over only part of the length of the thread in the nut; and where there is contact, the threads have been distorted. When the screw is exposed to the load, due to the pressure brought upon it by the machinery parts that it is supposed to hold together, it is liable to work loose, because of insufficient contact between the threaded parts.

It is often attempted to overcome this difficulty by employing lock-nuts as substitutes for accuracy in the threads. Diagram *B* shows the ineffectiveness of a lock-nut. Fine-pitched threads are easier to force into contact with each other than coarse-pitched ones; but the finer threads are also easier to destroy, and when the two parts are hardened, these finer threads are often broken off altogether. The original trouble of the wrong lead of thread has never been fully overcome by the employment of any substitute. On the other hand, if the lead in the nut and the screw are the same, all the threads in the nut are in contact with the screw. In tightening the nut, no yielding will take place, and the friction obtained throughout the length of the thread will keep the nut from vibrating loose or the thread from yielding. (See diagram *C*). Even if a nut fits loosely on the screw, but has the same lead as the screw, it will hold tightly with moderate pressure; this condition is indicated by diagram *D*.

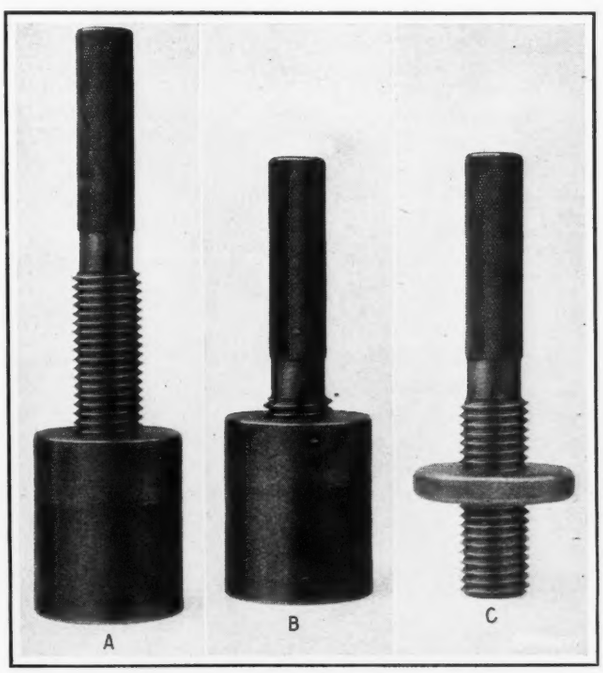


Fig. 2. (A) Nut tapped with 1-inch U. S. Standard Tap; the Screw has an Accurate Thread of Same Lead as Nut and is screwed in only One Thread, yet there is no Shake. (B) Same Nut and Screw shown at A. Nut is 2½ Inches Long and the Screw may be easily run right through and fits uniformly for the Full Length. (C) Thin Nut threaded with Tap finished after hardening; an Accurate Screw fits this Nut easily but without Shake

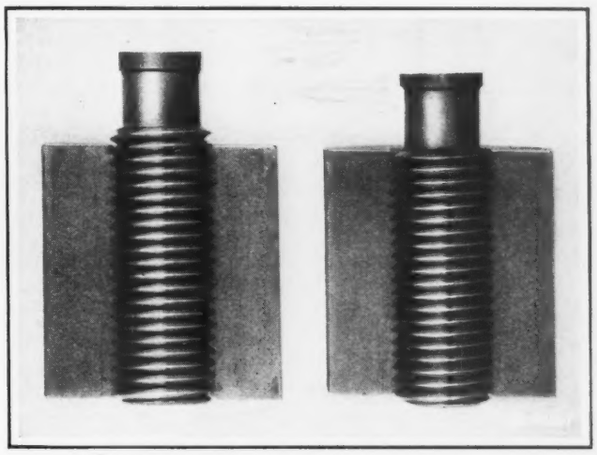


Fig. 3. (View to Left) Threaded Plug with a 1-inch U. S. Standard Thread laid in a Half-nut tapped with a Precision Tap, showing Perfect Contact; (View to Right) Threaded Plug of Accurate Diameter but 0.003 Inch per Inch Long in Lead will not go into the Same Half-nut shown in Right-hand View

Every experienced engine-, locomotive-, or turbine-builder has had trouble in fitting studs into cylinders and similar parts. The stud is screwed into a tapped hole. Generally it fits loosely in the first threads and tightens after being screwed in further. The tightening is due to the difference of the lead in the two members, and it is taken for granted by the workman that he has a good tight fit. When the cylinder head is mounted and the nuts tightened on the stud, the threads of the stud in the casting will yield under the pressure; but when the cylinder head is to be removed and the nuts are to be taken off, it is often found that the stud will come out with the nut instead of staying in the tapped hole in the cylinder. If the lead of the thread in the hole and on the stud were the same, the stud could be made to fit throughout the length of the hole and every thread would then do its part in holding the stud firmly in place.

Care in Making Fine Thread Gages to Control the Size of Screws

The methods for making gages for measuring and inspecting screws have developed considerably during the last fifteen years. When good work is required, the screw maker is held down to very close limits. In many cases not even a maximum and a minimum gage are used for testing a screw thread. The screw in that case is expected to fit with an even friction in only one gage. As the die is adjustable, it is possible to meet this requirement. But is it not incongruous when you stop to consider the matter, that after having made all of these fine screws and inspected them with this very fine gage, they are put into holes that are tapped with a tap that often has a thread with an inaccurate lead, and that has a fairly large tolerance on its diameter? Furthermore, all of the holes for these fine screws are not always tapped with the same tap, and when screws are made to fit fairly satisfactorily in a hole tapped with one tap, they will not fit a hole tapped with another tap, although the taps are supposed to be of the same size.

Furthermore, taps are often slightly bent in hardening, the lead being a little longer on the convex side than on the concave side; and although the diameter may be fairly close to size, as measured with a ball micrometer, it will not tap

a hole of the same size as its own diameter on account of being bent. I have had experience with taps measuring very nearly the same in diameter, yet one tapped a larger hole than the other. This was due to one tap being straighter than the other. After a long experience with and study of this problem, I have come to the conclusion that the majority of difficulties in thread fitting are due to the inaccuracy of taps, and if taps are made accurate in lead and diameter, most of the troubles experienced in fitting threaded parts are likely to be overcome.

Work of Engineering Committees

Great efforts have been made by committees of experienced men to eliminate the errors in the various types of thread-cutting tools; and great strides have been made in establishing tolerances that would be within so-called "commercial limits." If the market can be supplied with an accurately made tap, this problem will solve itself; and if screws and threaded holes can easily be held to a predetermined size, according to standards in vogue, the committees will be relieved of the task of establishing tolerances that will suit everyone's requirements.

Fig. 4. Taps with Threads finished after hardening; at the Right is shown a ⅜-inch Tap with 100 Threads per Inch

In order to illustrate the effect of differences in lead on the diameter of the screw in relation to the nut, a carefully conducted series of experiments was recently made by the Hartford Tap & Gauge Co., Hartford, Conn., who is now producing taps for the market with threads finished after hardening by a process developed by them. A 1-inch tap with eight U. S. standard threads per inch, 2½ inches long, was made and finished after hardening. This tap was carefully measured and found to be correct in the lead within 0.0001 inch in three inches. A nut 2½ inches long was tapped with this tap. A plug was then made 0.0003 inch smaller in diameter than the tap, but of exactly the same lead. In screwing this plug into only one thread in the nut, as shown at *A* in Fig. 2, there was no shake, yet the plug could be screwed in the whole length of this long nut with two fingers, so as to occupy the position shown at *B*. The engagement between the threads of the nut and the screw is shown in diagram *D*, Fig. 1.

Another plug was made with the lead about 0.0035 inch long to the inch, and this was also accurately finished after hardening. This plug would only go in one thread in the nut and would then stick. Probably by applying a wrench it could have been screwed in two more threads which would, of course, have distorted the thread in the nut. The plug was then reduced until it would just go through the whole length of the nut, and by that time it was 0.013 inch smaller in diameter than the first plug made to the correct lead. The last plug fitted partly on one side of the first thread and on the opposite side of the last thread in the nut, as shown in diagram *E*, Fig. 1. In all the intermediate threads there was no contact. After this, the nut was carefully split longitudinally so that exactly one-half of the nut remained. By taking the two plugs and dropping them into the half-nut, as illustrated in Fig. 3, it was shown very plainly what actually takes place when a screw is fitted to a nut where the leads of the respective parts do not correspond with each other.

Solution of the Difficulty in Fitting Threaded Work

Owing to all the difficulties encountered in making and fitting threaded parts, engineers have carefully considered how much of this evil can be tolerated, and many discussions have taken place as to how this evil could, so to speak, be standardized within reasonable limits. I believe it is better to do away with the evil than to standardize it. The screw makers and the tap makers have been brought together, and are both well acquainted with the difficulties connected with the manufacture of each other's products. They have made honest efforts to minimize them as far as possible, but in my opinion they will not be overcome until methods are used for making taps of a predetermined diameter and lead, and that can be done only by finishing them after hardening.

In 1891 I started to make accurate taps for a special purpose and at a very great expense, but they were beyond commercial reach. From time to time I succeeded in making improvements in the method of producing such tools; but today I can state that this problem of producing accurate taps has been solved on a commercial basis. Fig. 4 shows examples of these precision taps as manufactured by the Hartford Tap & Gauge Co.

After making several tests as to the wearing qualities of taps that are corrected after hardening, I was surprised at the increase in the life of the taps. These taps were also corrected on the chamfered part after hardening, so that the taper was uniform, and each tooth made to take its proportionate part in cutting the thread; hence the increase in the life of the tap.

* * *

THE WASTE OF GASOLINE

Dr. A. C. Fieldner, supervising chemist of the United States Bureau of Mines, Experiment Station at Pittsburg, Pa., has found as a result of extensive investigations that nearly one-third of the gasoline used in automobiles is wasted. The experiments were conducted to ascertain the pollution of the atmosphere of the vehicular tunnels now under construction in New York City, by motor vehicles. The experiments were made under the same conditions as apply to actual traffic. The chief cause of the waste is a too rich gasoline mixture. An improved form of carburetor should be devised, which should be practically automatic in operation. On the basis of 34 cents per gallon, American automobilists are using about $115,000,000 worth of gasoline a year, of which, according to Doctor Fieldner, about $34,000,000 could be saved by improved methods, largely in better construction and operation of carburetors.

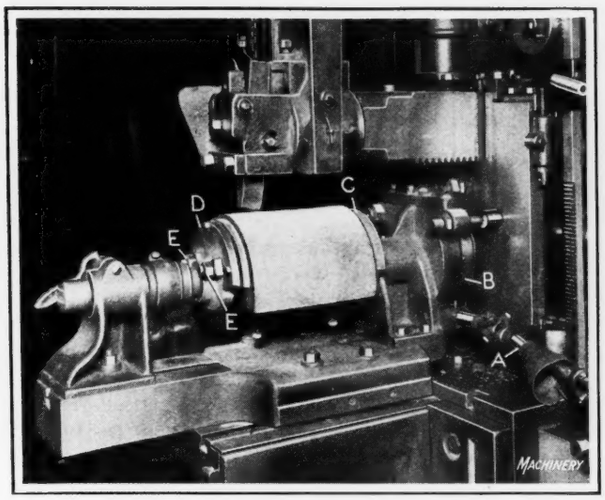


Fig. 1. Draw-cut Shaper equipped with a Special Rotary Fixture for machining the Outside of Driving-box Brasses

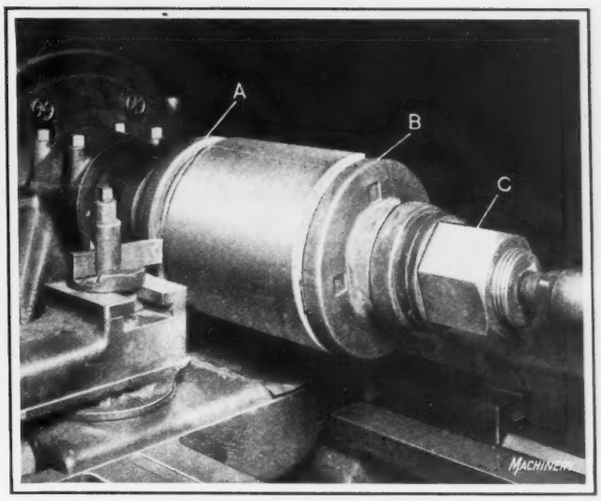


Fig. 2. Special Mandrel with Serrated Collars for holding Driving-box Brasses while turning the Outside Surface

Railway Machine Shop Practice

Methods Used in Machining Crown Brasses, Driving-boxes, and Shoes and Wedges

Fourth of a Series of Articles

IT is always interesting and instructive to compare the methods used in different shops for performing the same operation on any given class of work. As a case in point, consider the work of machining the outside of crown brasses for locomotive driving-boxes. One would scarcely expect to find the same operation successfully performed on either an engine lathe or a shaper, but such is actually the case. By referring to Figs. 1 and 2 it will be seen that a draw-cut shaper and an engine lathe are each shown engaged in finishing the outside of a crown brass ready for it to be pressed into the box.

The machine illustrated in Fig. 1 is a draw-cut shaper built by the Morton Mfg. Co., of Muskegon Heights, Mich. It is shown in use in the Burnside shops of the Illinois Central Railroad Co., in Chicago. To adapt this equipment for the required service it will be seen that from the feed gears power is transmitted through a universal-joint horizontal shaft *A* to a worm and worm-wheel contained in case *B*. Connected to the worm-wheel there is an arbor on which the work is set up, so that as the shaper tool is reciprocated back and forth the work may be rotated under it at a uniform rate of speed, thus providing for the generation of an accurate cylindrical surface. It will be seen that this arbor has a fixed collar *C* and a collar *D* that is held in place by two bolts *E*. On their inner side these collars are serrated so that as the bolts are tightened, the serrations can bite into the work and enable the collars to obtain a secure grip.

In performing this same operation of machining the outside of crown brasses for driving-boxes, the Chicago & Northwestern Railway Co.'s shops in Chicago make a practice of setting this work up in an engine lathe, as shown

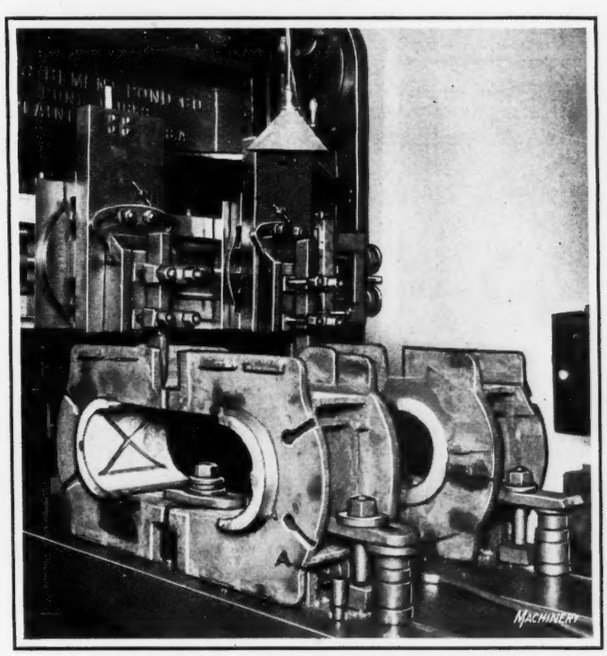


Fig. 3. Method of setting up Four Driving-boxes for replaning, after pressing in the Bearing Brasses

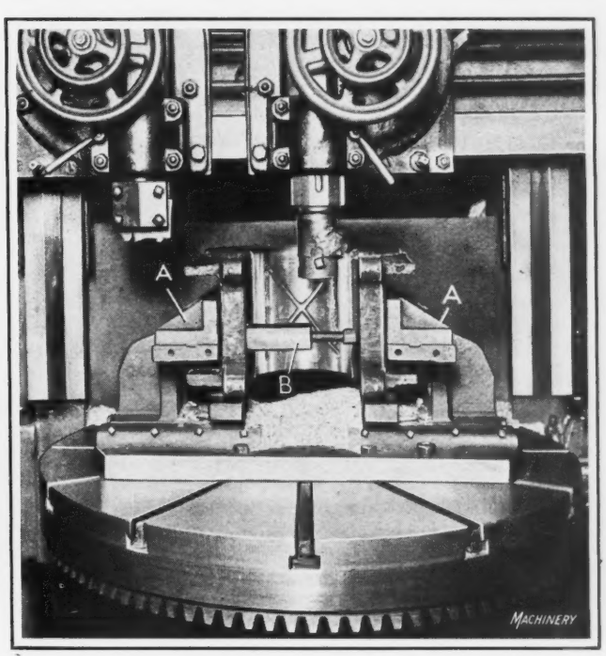


Fig. 4. Method of boring the Bearing Brass, after pressing it into Place in the Driving-box

in Fig. 2, and it will be seen that an arbor is provided on which the casting is held between centers. This arbor is furnished with a fixed collar *A* and an adjustable collar *B*, these collars being serrated on their inner sides in the manner just described in connection with the draw-cut shaper job. It will be seen that there is a nut *C* on the threaded end of the arbor, which is tightened with a long-handled wrench to provide for holding the work with the required degree of tightness.

Method of Assembling Brasses into Driving-boxes

Regardless of whether crown brasses are being pressed into new driving-box castings or whether they are being replaced in old ones, the method of procedure is to press the brass into place with a hydraulic press. During this process, the forcing of the brass into position tends to spread the sides of the box, so that even in the case of an old one which has already had the fits planed to receive the shoes and wedges, it is necessary to replane the work to bring it to the required degree of accuracy. In performing this

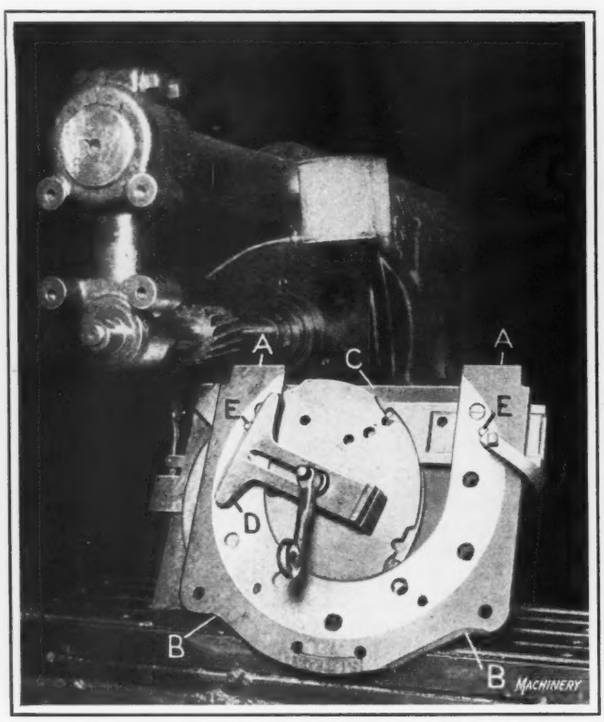


Fig. 5. Milling the Tapered Clamping Surfaces of a Removable Lateral Bearing Plate for a Driving-box

operation, the object is to make the two sides of the driving-box exactly parallel and still to remove a minimum amount of metal.

The method of procedure in handling this work in the shops of the Chicago & Northwestern Railway Co. is to first take a light cut over one side of the box to clean up the surface, then to turn the work over and place this previously planed face on a parallel strip *A*, Fig. 3, on which the driving-box is strapped down ready for planing the other side, thus assuring parallelism of the fits for the shoe and wedge. In Fig. 3 is shown a planer built in the Pond Works of the Niles-Bement-Pond Co., Plainfield, N. J., on which two pairs of driving-boxes are set up side by side, so that tools carried by the two rail-heads of the planer can operate simultaneously. This saves time through taking advantage of economies of production that result from applying the multiple method of setting up work.

Boring the Driving-box Bearing Brass

After the sides of the driving-box have been planed on the machine shown in Fig. 3, the work is transferred to a vertical boring machine built in the Bement-Miles Works of the Niles-Bement-Pond Co., in Philadelphia, Pa., on which each driving-box is chucked from the previously planed shoe and wedge fits, for boring the inside of the bearing brass, as shown in Fig. 4. It will be seen that the fixture by which the driving-box is carried is furnished with two jaws *A*, and in order to prevent the pressure of these jaws from springing the work inward, and thus causing the accurately bored bearing to be sprung out of shape when the jaws are released, a jack *B* is placed inside the box in the position shown. There is nothing unusual about the actual method of performing the boring operation.

On driving-boxes for engines owned by the Chicago & Northwestern Railway Co., there are two methods of applying lateral bearings. One of these is to apply babbitt to the face of the driving-box, while the other is to employ a separate bearing plate which is made as a self-contained unit, so that it may be removed and a new bearing substituted without the necessity of taking off the driving-box and sending it to the shop to have the bearing rebabbitted. But regardless of which type of lateral bearing is employed,

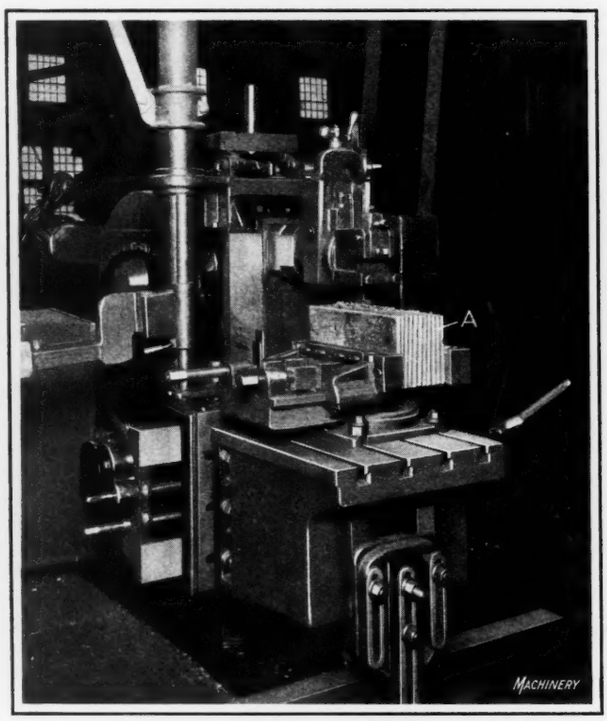


Fig. 6. Draw-cut Shaper used for planing Edges of Sheet-steel Shims for adjusting Worn Driving-boxes

the driving-box, as it comes to the boring mill shown in Fig. 4, has had the lateral bearing repaired, if necessary, and a facing operation is performed on the babbitted surface of the lateral bearing while the driving-box is set up on the boring machine.

Milling Lateral Bearing Plates

Where detachable lateral bearing plates are employed, it is the practice of the Chicago & Northwestern Railway Co.'s shops to have an under-cut bracket at each corner of the driving-box, by which the upper end of the lateral plate is held; and there are sliding clamps that are under-cut to fit over the lower corners of the plate, these clamps being held in position by means of suitable bolts. In Fig. 5 is illustrated a No. 4 heavy-duty milling machine built by the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, that is furnished with a fixture to provide for milling the inclined corners *A* and *B* of the lateral plate, to fit under the brackets and clamps that hold this plate in position on the driving-box.

It will be evident that the fixture is furnished with an inclined plate *C* on which the work is held by means of a

strap *D*, so that by feeding it under the plain milling cutter on the machine, the edges *A* and *B* of the corners of the work are milled to the required angle of inclination with the face of the plate. In the fixture there are two pins *E* which enter holes in the work to locate it in the position shown; these pins also provide for obtaining the required second and third settings of the work for milling the lower corners *B* that are engaged by the clamps which hold the lateral bearing plate in place on the driving-box.

Planing Shims for Worn Locomotive Driving-boxes

There are various methods of procedure in refinishing worn driving-boxes of locomotive engines that come to a railway machine shop to be overhauled. At the Burnside shops of the Illinois Central Railroad Co., it is occasionally necessary to use packing shims made of sheet steel, to compensate for wear that has developed on the shoe and wedge faces of driving-boxes. These shims are of rectangular form, and after the rough blanks have been sheared out of a sheet, a practice is made of setting up ten blanks *A* between the jaws of a vise mounted on the table of a draw-cut shaper built by the Morton Mfg. Co., as shown in Fig. 6, to provide for accurately planing the edges of these blanks, so that each edge is smooth and parallel to the opposite side of the shim. By setting up a number of blanks in this manner, a saving of time results from having the non-productive time required for setting the cutting tools distributed over a number of pieces of work.

Planing Driving-box Wedges

Most mechanics who have done any work in railroad shops or locomotive building plants, know that the driving-boxes are held in place between the jaws of the engine frame by means of two members known as a "shoe" and a "wedge," respectively. One of the frame jaws is straight, and the shoe goes between the driving-box and this jaw. At the other side, the jaw is tapered and the wedge is placed between this jaw and the driving-box, so that by adjusting the position of the wedge, it is an easy matter to take up lost motion between the driving-box and the frame of the engine. With an arrangement of this kind, the driving-box is free to move vertically between the jaws, but it cannot have lateral movement which would be undesirable.

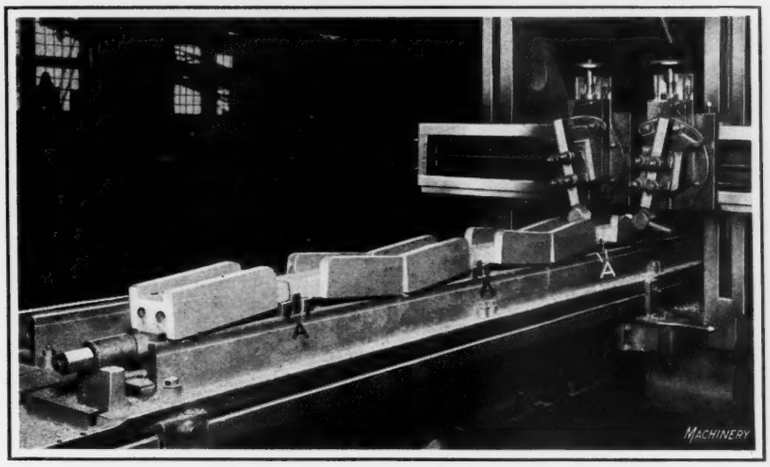


Fig. 7. Method of setting up a String of Six Wedges for planing the Tapered Surfaces

Fig. 7 illustrates a planer built at the Niles Tool Works of the Niles-Bement-Pond Co., which is equipped for the planing of wedges in the Burnside shops of the Illinois Central Railroad Co. It will be seen that the work is strung up along the planer table, with suitable sized blocks *A* under one end of each wedge, so that the work is held in the proper position for planing the inclined side to the required taper. The sides of the wedges are also planed at this setting, as shown in the illustration, but aside from the method of setting up the work for the taper planing operation, and the fact that the work is done at one setting, there is nothing in any way unusual about the performance of this job.

* * *

According to United States Geological Survey reports, the total world output of coal in 1920 was about 1,300,000,000 metric tons, as compared with 1,342,000,000 metric tons in 1913.

HOLDING THIN WORK FOR MACHINING

By F. E. CHACE

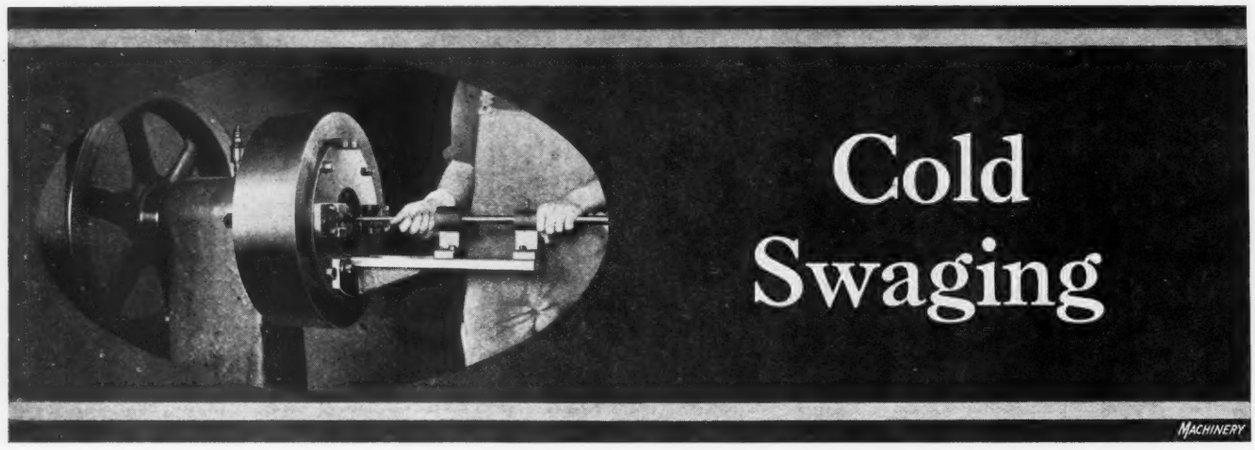
The problem of holding thin and delicate work while it is being machined frequently taxes the ingenuity of the machinist. While the magnetic chuck is now in great demand for holding thin work, and is used on grinding machines, lathes, and planers, for this purpose, there are nevertheless instances in which it cannot be employed and some other means must be provided. For many years instrument makers and other metal workers have made a practice of attaching thin brass work to a flat plate, or directly to a lathe faceplate, by means of soft solder. This method of fastening work is exceedingly useful in some instances, and would no doubt be employed to a greater extent if more generally known. A disk or block of brass or steel, if it has one flat side of sufficient area, can be soldered to a faceplate, thus eliminating danger of distortion from chuck jaws. Work attached in this way can often be finished completely in one setting; for instance, in the case of a thin disk, a hole may be bored in the center, the face finished parallel with the back, and the outside diameter turned concentric with the hole at one setting of the disk.

This method can also be used to advantage for certain kinds of planer work. The writer once employed this method in making a long, thin, tapered gib of steel. The stock for the gib was soldered to a square steel bar, and the three sides were planed in this position, thus finishing the gib to the required size and angle without changing the setting of the bar or work. One advantage of this method which the magnetic chuck does not have is that brass may be held as effectively as steel. Another advantage is that work set up in this manner may be taken from one machine to another; for instance, from a planer to a drilling machine or grinding machine. Often this permits the work to be completely finished while fastened to the metal holder.

Thin cast-iron pieces cannot be fastened in this manner, because soft solder will not readily adhere to cast iron. Cast iron may, however, be cemented to a faceplate. In this connection the writer has in mind a case in which rosin was used as a cement to fasten some thin cast-iron plates on a planer bed. The plates were quite thin, but they were of considerable area and were therefore easily cemented in place with the melted rosin and planed.

Another kind of work that is difficult to clamp and machine without distortion is a slender or delicate spider-shaped casting or any similar piece that offers no suitable chucking surface. Such work must be carefully handled in order to prevent the thin walls or slender arms from becoming broken or distorted. A casting of this kind can sometimes be immersed in molten lead in such a way as to leave the surfaces to be finished in the proper position for machining when the lead hardens. This will prove an effective method of holding many awkward shaped pieces.

A thin metal cylinder or tin can may serve as a container for the molten lead. This lead-filled cylinder with the work embedded in it may be gripped by the chuck jaws of a lathe. If antimony is added to the molten lead the metal will be harder when cold.



Methods Employed by the Torrington Co., Torrington, Conn., in Making Swaging Dies
Second of Two Articles on the Subject of Cold-swaging

IN the first article on cold-swaging published in the June number of MACHINERY, the application and the limitations of the swaging process were dealt with. The effect of swaging on the physical properties of the metal was explained, the principles of the swaging machine were outlined, and types of swaging work shown, together with rates of production. The present article will deal with the steel used for swaging dies and its heat-treatment, the machining of the die-blanks, and the use of the projectograph for swaging-die inspection.

Steel for Swaging Dies and its Heat-treatment

Experience governs the selection of the steel to use for swaging dies, and this automatically determines the heat-treatment that it is to receive, for it is the usual custom of steel manufacturers to furnish information regarding the heat-treatment of their several brands of steel used for various purposes. It has been determined by the Torrington Co., through trials of various steels and by the use of different methods of heat-treatment, that a brand of steel that is good for one size and service of dies will not necessarily prove the best for another type, no matter how it is treated.

The service to which swaging dies are subjected is somewhat different from that of forging or press-work dies, in that, in swaging, the dies are brought rapidly and repeatedly against the work so that the steel must withstand this destructive action without fracturing. At the same time, the dies must have a sufficient degree of hardness to insure a reasonable length of life. The heat-treatment department of the Torrington Co. is equipped for handling the die hardening work according to the highest degree of development which this branch of die manufacture has attained within the last few years. There are a number of Gilbert & Barker oil-burning furnaces in which the tool-steel swaging dies are heated for hardening; a Triad three-purpose oil-burning furnace manufactured by W. R. Bennett, Elmwood, Conn., in which the high-speed steel is heated; a cyanide bath furnace for tempering high-speed steel; and the customary oil-tempering furnaces, quenching tanks, etc. The furnaces are all equipped with electric pyrometers manufactured by the Bristol Co. of Waterbury, Conn.

The steel used in this plant for the medium-sized dies is the Crucible Steel Co.'s "Crescent" special cold-drawn steel, and for the small and the large dies the steel used is manufactured by Hobson, Houghton & Co. and is their "Warranted Best" brand. High-speed steel is used only in the manufacture of dies for hot-swaging. These three steels, properly heat-treated, have given the best service under the destructive battering-down action that the dies are subjected to in swaging work. Tool-steel dies are heated to 1460 degrees F., and are quenched in brine at an atmospheric temperature. They are then drawn in oil at 350 to 360 degrees F. For heat-treating high-speed steel dies, the Triad furnace is run at 2100 degrees F., and the work transferred to the bath-tempering furnace, which contains a solution of caustic soda, salt, and cyanide at a temperature of 600 degrees F. The work is removed from the cyanide solution and cooled on the floor, after which it is immersed in boiling water for a period of three or four minutes to remove the scale.

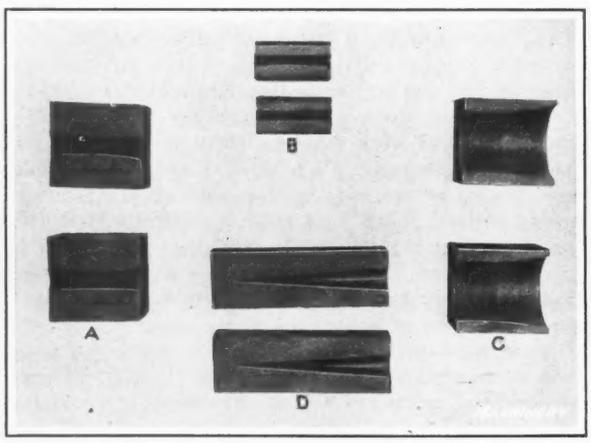


Fig. 1. Examples of Different Classes of Swaging Dies: (A) Straight Solid Stock; (B) Threaded Rods; (C) Tube Reduction; (D) Tapered Tubes

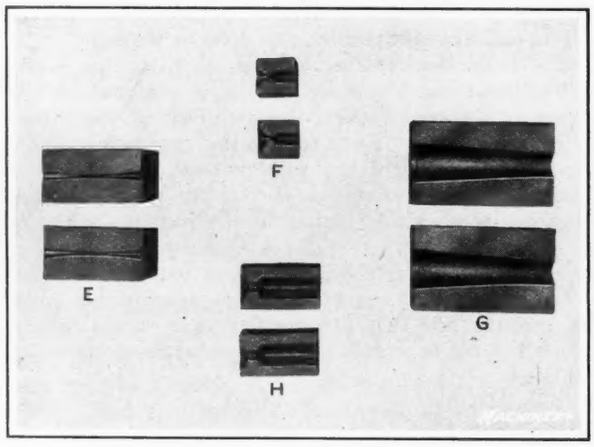


Fig. 2. Additional Examples of Swaging Dies: (E) Needle Work; (F) and (H) Dies used in Hot-swaging Process; (G) Tapered Solid Stock

Machining the Die Blanks

The methods employed in machining the die blanks are not unusual, but an outline of the general practice of the Torrington Co. will be given in the following. A collection of swaging dies used for various types of work is shown in Figs. 1 and 2. The dies shown at *A*, Fig. 1, are used for the straight reduction of solid work, for sizes 2 inches and under in diameter. At *B* is shown a pair of threading dies such as are used in threading rods. It should be mentioned, in connection with the production of threaded rods by swaging, that the work is positively fed through the dies and that it does not revolve, the thread being formed as the dies are rapidly advanced on the work during the course of their revolution. The dies shown at *C* are for reducing the diameter of tubes. It will be noticed that in all dies employed on straight reduction work, or for threading, provision is made for facilitating the entry of the work into the dies by bell-mouthing the blade, as clearly indicated in this illustration. The pair of dies shown at *D* was used in the production of the lightning-rod ends shown at *F*, Fig. 4, in the previous article published in the June number. These parts are made from copper tubing and have a uniform taper, the dies illustrated being typical of those used for the tapering of tubular work.

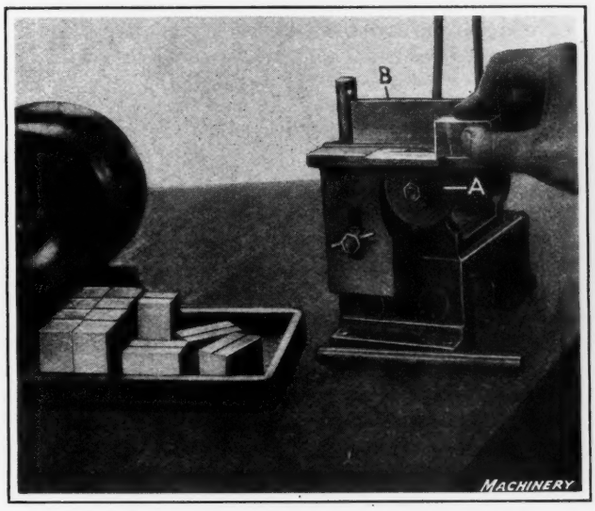


Fig. 3. Die-slotter which is employed for grinding Blades of the Smaller Size of Dies

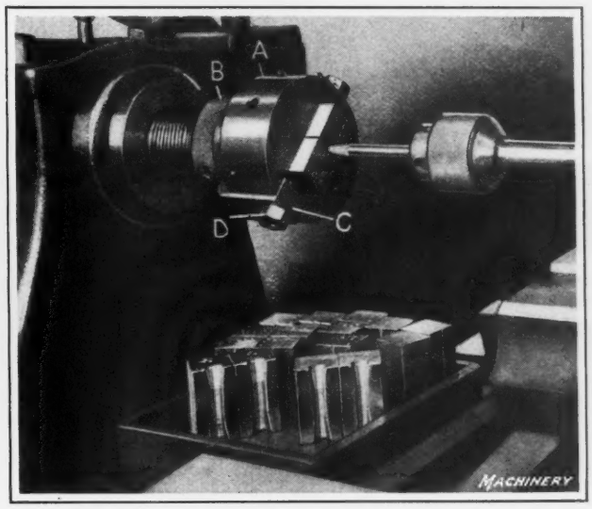


Fig. 4. Lathe equipped with Chuck for holding a Pair of Blanks Central while machining the Blade

A pair of dies used in the production of needles is shown at *E*, Fig. 2. Needle work may be classified as the straight reduction and pointing of small wire, and the work is invariably produced on machines having a maximum capacity of 3/16 inch. *F* and *H* illustrate the appearance of swaging dies used in the manufacture of certain classes of work by the hot process. The smaller pair of dies has a capacity for handling wire under 1/16 inch in diameter, and the pair shown at *H* for wire sizes not greater than 3/32 inch. The distinguishing characteristic of the dies used in the hot-swaging process is the short blade. The dies shown at *G* are for tapering solid work 3/8 inch and under in diameter. Besides the types of swaging dies shown in these two illustrations, there is also the step die for swaging two diameters at a time. The use of dies of this type enables greater reductions to be made without the employment of separate dies, which, of course, results in considerably increasing the production rate.

After the blanks have been squared up, the die groove, which for straight reduction work is termed the "blade," is machined. For the smaller size of dies, this blade is produced by grinding on the special die-slotter illustrated in Fig. 3. This slotter carries a Waltham Grinding Wheel Co.'s 100-grain, grade E wheel for producing the blade in the smallest dies, such as shown in this illustration; and a Vitrified Wheel Co.'s 80-grain wheel for producing all other blades which are to be finished by grinding. The operation performed on the machine shown in this illustration is a simple one, and involves merely the passing of the blank back and forth over the wheel *A*, against the adjustable guide *B*, and repeating the operation with the work turned around. The object of reversing the work is, of course, to centralize the blade in the die-block.

For the larger size, the blade is first rough-machined by planing on an ordinary tool-room shaper. The practice of planing the blades of the larger dies assures that the blade will not run out during the subsequent reaming operation by means of which the planed blades are semi-finished. The varying hardness in the steel of mating dies may be sufficient to cause considerable difficulty in maintaining exact duplicate blade grooves, unless the preliminary operation is performed with the work rigidly supported and by the use of a substantial tool, as in planing. Before the blanks are planed, however, they are counterbored at the ends, as shown in Fig. 4. The machine used for this operation is a Blaisdell lathe, equipped with a holder *A* in which a pair of dies may be held and centralized. This holder fits the regular lathe spindle, and has a knurled adjusting collar *B* for opening and closing the jaws *C*. The provision for centralizing the work in the holder or chuck consists of two adjusting screws *D* carried in the jaws.

The radius of the counterbore thus produced determines the depth to which the blade is subsequently planed. All finishing operations on the larger size of dies are performed with equipment similar to that shown in this illustration, so that the mating members may be held in pairs during the machining operations, which consist of boring and reaming the straight blades (except where this is performed on the slotter, Fig. 3) and of reaming the taper recesses in dies of the type shown at *D*, Fig. 1, and at *G*, Fig. 2. The taper at the end of the straight blades is also produced by reaming. Ordinary tools, such as single-point boring tools, and straight and taper reamers, are used in the performance of these operations.

The blades, of course, are not a full semicircular recess, for if they were, the dies would be closed together in service and there would not be any provision for the flow of metal. Consequently the die blanks must be clamped in the holder (Fig. 4) during the machining of the blade and its tapered mouth, the adjacent sides of the dies being separated by a spacing block of the proper thickness, thus producing a circular recess not quite as deep as a semicircle. Naturally the amount that each blade is under a full semicircle increases with the size of the work, in order to make provision for the greater flow of metal in the larger sizes of dies.

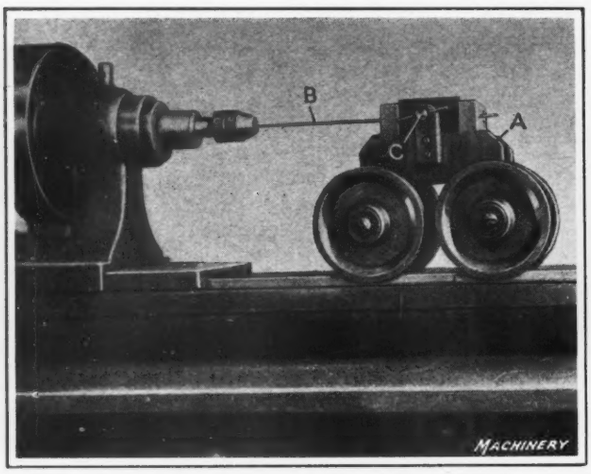


Fig. 5. Bench Lathe with Special Wheel Carriage in which the Dies are held during the Lapping Operation

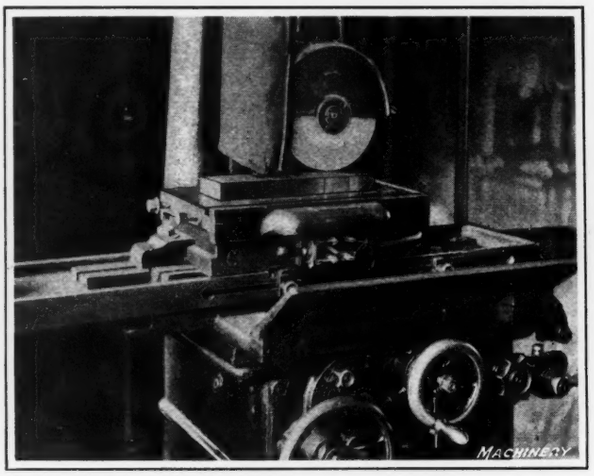


Fig. 6. Surface-grinding the Die Blanks to obtain Uniform Height. The Work is located on a Magnetic Chuck

Final Operations on the Dies

All blades and die grooves are finally finished by lapping. The lapping operation is performed on a specially constructed bench lathe, on the bed of which a special carriage mounted on wheels travels on a track. This equipment is illustrated in Fig. 5, from which it will be seen that the lapping fixture *A*, supported on the carriage, enables the lapping wire *B* to size the blades in mating dies as the carriage traverses back and forth on the lathe bed. The dies are clamped in place by a thumb-screw *C* during the operation. The lap consists of an ordinary piece of soft steel wire, and the lapping compound used is a mixture of flour emery and oil.

For dies used on the ordinary class of straight reduction or in the production of tapers, the practice is to lap the blade only after the heat-treating process. When the dies are to be used for swaging plated work or for solid gold, silver, or platinum wire, they are lapped both before and after heat-treating. This is a precautionary measure to safeguard against the possibility of imperfections in the finished blade surface, as any roughness or irregularity would tend to abrade the surface of the metals. It will be appreciated that only a slight surface defect would injure swaged work of this kind.

Hot-swaging dies, which are made of high-speed steel, are manufactured by a process similar to that described for the smaller cold-swaging dies. Mention has already been made in connection with the hot-swaging dies shown in Fig. 2, of the fact that the blade is comparatively short, the purpose of this being to reduce the likelihood of the stock cooling rapidly during the swaging operation. It will be appreciated that if this blade were as long comparatively as the blades of the cold-swaging dies, the additional metal in contact with the hot work would tend to dissipate the heat rapidly, causing the heated metal to drop below the correct swaging temperature before the operation was completed. As a general rule it may be stated that the length of this blade is equal to its diameter. These hot-swaging dies wear much faster than other dies, but the rapid increase in the diameter of the blade does not affect the serviceability of the dies as much as might be supposed, for after they become worn they are simply remachined and used for swaging larger sizes of wire.

The final machining operation on the die blanks consists of grinding the face of the dies on a B & S No. 2 surface grinder equipped with an O. S. Walker magnetic chuck and a Norton alundum wheel, 38 to 46 grain, grade G. This machine is illustrated in Fig. 6, in which a number of dies are shown on the magnetic chuck. This grinding operation is not for the purpose of producing any given gage thickness, but to assure uniformity in thickness for each pair of dies. In other words, the amount of stock removed is just enough so that the lowest top die surface (as the dies are held on a chuck) will be cleaned up.

The reason that mating dies must have the same thickness will be readily understood by again referring to Fig. 1 in the article in the June number. In this connection attention is directed to the method of setting up the swaging machine. Between the dies and the backers, suitable shims are used; the thickness of these shims is such that when the pulley of the machine is turned by hand and the dies are forced toward the center, there will be a space between the adjacent faces of the dies, which is sufficient to permit the metal to flow as it is being reduced, without producing a fin on the work. Therefore, if each die is not ground to an equal thickness it becomes difficult, if not impossible, to shim up the dies so that this space between them will be centrally located. If this is not accomplished, the resulting work will be unevenly and improperly swaged. It is evident that if this space is off center, blows of unequal

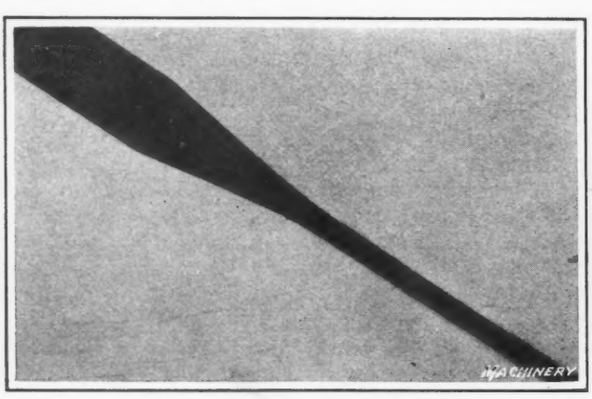


Fig. 7. Projectograph of a Needle of 0.07 Inch Diameter taken at a Magnification of 50 Diameters

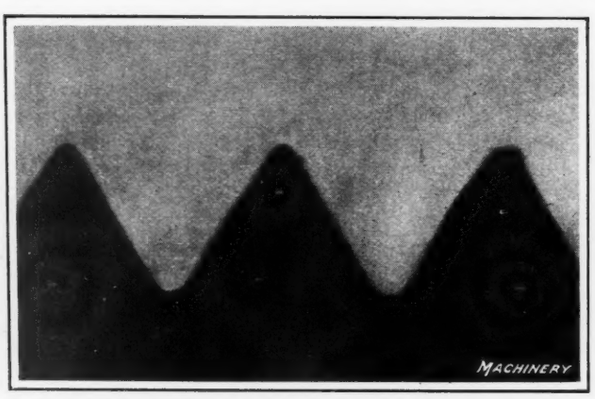


Fig. 8. Swaged Thread projectographed to show the Contour. The Magnification is 50 Diameters

force will be applied by the dies and the work will consequently be imperfect and its structure undependable.

Use of the Projectograph for Swaging Die Inspection

The lantern projector apparatus, shown at the right in Fig. 3 in the June number, is manufactured by the Greenfield Tap & Die Corporation for the National Physical Laboratory of Great Britain. An apparatus of similar design to that illustrated was described in the October, 1920, number of MACHINERY. Use is made of this projector in the laboratory of the Torrington Co. in connection with the manufacture of the swaging dies. The machine has a magnification of fifty diameters, so that the condition of the dies may be determined by inspecting a projectograph of the matrix of the die or of a piece of swaged work.

The projectographs reproduced in Figs. 7 and 8 emphasize the value of such an inspection means for detecting imperfections in the die surfaces. Fig. 7 shows a needle of 0.07 inch diameter after being swaged in a pair of dies, and enables the irregularities in the blade, produced either by wear or by improper machining, to be easily detected. Mention has been made in a previous paragraph of the quality of product which may be realized in the manufacture of threaded rods by swaging. The projectograph of swaged threads shown in Fig. 8 is self-explanatory. The thread form, it will be seen, is exceptionally good, although it is not in respect to thread form that the swaging process is most efficient, but rather in the lead.

On precision work such as the sizing of wire or for work encountered in needle manufacture, it will be appreciated that the existence of worn surfaces must be detected before it has advanced far enough to produce unsatisfactory work. The detection of this wear probably cannot be accomplished with such a degree of positiveness as by the use of the projectograph apparatus.

* * *

PRIZE FOR HARDNESS-TESTING APPARATUS

A prize has been offered by Sir Robert Hadfield, through the Institution of Mechanical Engineers of Great Britain, for the best design for an apparatus to determine the hardness of materials accurately, and which is suitable for application in metallurgical work for cases in which methods now in use are not fully satisfactory. The present fund amounts to £154 sterling (about $600, present exchange). The award or awards will be made by the council of the institution. A portion of the fund may be awarded for communications which advance the knowledge of methods of testing hardness. All communications should be accompanied by scale drawings or by models or examples of the apparatus; if likely to be of commercial value, provisional protection should be obtained before submitting them. Communications should be addressed to the Secretary of the Institution of Mechanical Engineers, Storey's Gate, St. James Park, Westminster, London, S. W. 1, and should reach him by December 1, 1921. They should be marked "Method of Determining Hardness."

* * *

RECONSTRUCTION IN FRANCE

The reconstruction work in France, especially in regard to railroads in the devastated regions, has been proceeding rapidly; 1500 miles of double-track line totally destroyed during the war have been completely reconstructed. Of the 1700 miles of single-track line destroyed, 1150 miles have been entirely reconstructed and opened for traffic; the remainder is being converted into double-track lines. Orders for 1200 locomotives and 2500 freight cars have been placed. The work of electrifying certain French roads, started last year, is making rapid progress. Two French railroads have started electrification plans that are said to include 4000 miles of road; in addition, the Midi Co. is planning to electrify about 2000 miles.

INDUSTRIAL CONDITIONS IN HOLLAND

By MACHINERY'S Special Correspondent

Amsterdam, June 12

Of late there has been a widespread movement in Holland for the rescinding of the law establishing the forty-five-hour week, due to its being considered, in some quarters, a menace to the industrial welfare of the nation. The government firmly opposes this, but it is inclined to issue special permits to firms having rush orders, allowing the concerns to operate over-time. The socialist movement has spread considerably, as shown by the municipal elections in the great industrial centers, and it is believed that these results forecast those of the general elections to be held next spring.

A number of articles have recently appeared in technical publications urging a much greater use of automatic and semi-automatic machines in the machine and shipbuilding industries, in order to eliminate the necessity of employing skilled workmen, as these are paid very high wages at present. The high cost of skilled labor in these industries is due to the inadequate supply and to the opposition of the labor unions to the training of unskilled workmen and the unemployed from other industries to meet this condition. However, as the unemployment in some industries ranges from 40 to 60 per cent and funds for the unemployed are becoming low, public opinion in general is supporting the government in its endeavor to train men for the industries that are short-handed in help.

Movement for Modernization of Manufacturing Methods

In pre-war days, labor in Holland was very cheap, as compared with the wages paid in Great Britain and the United States, but, while the cost of living has mounted so spectacularly during recent years, there has been no great increase in the efficiency of manufacturing methods, and so manufacturers and economists are aware that if methods are not modernized, Holland will be unable to continue to compete with foreign countries. A Bureau of Standards has recently been established by an organization of manufacturers for the purpose of standardizing all industries through the installation of new machinery.

Profits decreased considerably last year and stocks at present are low on the exchange, but the great majority of concerns set aside sufficient reserve funds during the war to enable the purchase of modern equipment. The feeling exists that if methods remain unchanged the various industries are likely to become paralyzed, and this is one of the reasons why the re-equipment of plants will no doubt be accomplished. Other reasons for the revolution of manufacturing methods are the interest displayed in lectures on scientific management, specialization, etc., and the desire to reduce the proportion of skilled workers necessary in a plant.

Latent Market for Machine Tools

Owing to present conditions, there are great latent possibilities for the sale of machine tools. However, there is also danger of all improvements ceasing if the labor unions obtain sufficient strength to bar mechanical progress. Manufacturers, of course, hesitate to invest money in plants threatened by such a condition. In considering the possibility of selling machine tools in Holland, it must be remembered that the Germans are always able to underbid British and American prices by from 10 to 20 per cent, so that British and American manufacturers can generally sell only such machines as either excel in quality or have special features. Besides this factor, German dealers always afford easier conditions of payment, usually giving credit until 30 days after delivery. The superior quality of American machines is generally recognized, but the distance of the United States from this country and the disinclination of American dealers to comply with the wishes of buyers with respect to the conditions of payment, are distinct hindrances to the sale of American machines

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WHAT IS NORMAL BUSINESS?

In 1914, according to the United States Government census, machine tools to the value of nearly $32,000,000 were produced in the United States. But 1914 was a quiet year in the industry, and many manufacturers say that the sales in that year were only about fifty per cent of the capacity of the existing machine tool plants. At full capacity, therefore, the value of the 1914 product would have been about $60,000,000, and as there was no over-expansion in the machine tool industry that year we may take that sum as representing what was then considered a normal business.

The United States census of 1920 gives the value of our machine tool production in 1919 as $212,000 000. For the month of January, 1920, it is estimated that our machine tool builders were producing at the rate of over $300,000,000 a year, and in that month the peak of machine tool production was probably reached.

When people now speak of a normal business in machine tools they usually make comparisons with the peak production, or with the high levels reached during the last two years of the war and the period of high-pressure business which began six or eight months after the armistice. The basis for comparison should be a figure between those obtainable for 1914 and 1919, and well below the figure for the latter year.

Statements that the machine tool business in certain lines at the present time is only 12 or 15 per cent of normal, convey an erroneous impression and are not only misleading, but unnecessarily discouraging. If a correct basis of comparison could be reached, it would doubtless be discovered that many machine tool manufacturers are not so far from a normal business condition as is generally thought to be the case.

* * *

FREE SERVICE FOR "SECOND-HANDS"

The marketing of a great number of slightly used machine tools since the war has brought up the question: To what extent should a manufacturer be expected to furnish free service to users of his machines who have bought them second-hand? In many instances the buyers of these second-hand machines request the manufacturer to send demonstrators to install them and train operators in their use. Having already originally rendered this service and not having made the later sale, manufacturers do not usually recognize any further obligation, and in most instances ask that the expense involved be met by the buyer of the second-hand machine.

This seems a reasonable position to take. The cost of many new machines bought directly from the manufacturer includes not only the machine, but also its installation and instruction in its operation. The greatly reduced price paid for a second-hand machine does not include this expensive service, but some purchasers are taking advantage of the present depression in machine tools and the eagerness of manufacturers to acquire their good will, to demand this service free, or make future purchases contingent on the satisfactory operation of the second-hand purchases, and some manufacturers, to insure the best results from their machines, are giving free installation service.

No one should blame a buyer under present conditions for getting as much as possible for his money. But the manufacturer is under no obligation to render this service for nothing, and if he pays out considerable real money for the buyer's good will, the latter should recognize and remember the obligation thereby created, for the buyer in this case really receives something for nothing.

* * *

STANDARDIZED MACHINE PARTS

An important saving can be effected in machine shop practice by extending the standardization of machine tool parts. If it were possible, for example, for lathe manufacturers to agree upon certain standards for toolposts, faceplates, spindle noses, and other parts, this standardization would result in considerable economies in all shops where machine tools are used. It would be comparatively easy to arrive at some common standard for T-slots for machines of similar type and size.

Another important extension of standardization concerns the motor builder rather than the machine tool builder. Motor manufacturers have not as yet been able to agree upon such standard dimensions for electric motors as will enable the manufacturer to place any make of motor of a given size and for a given current on his machine, without special provision for it. The motor manufacturers have made great progress in standardizing the electrical details, but apparently they do not yet fully appreciate the value of what may be called "mechanical standardization." By co-operation the motor manufacturers could agree upon certain frame designs that would place the shaft for the pulley at a given height above the support. The location of bolt holes should also be uniform, and the shaft diameter should be standardized so that the same pulley will fit on any motor of the same size and for the same current, irrespective of the make.

* * *

A SEVERE EXPERIENCE FORGOTTEN

One of the lessons that many manufacturers learned during the high-pressure period of the war and the busy years immediately following, was the necessity for training workers, because skilled men were almost unobtainable. Now that this necessity has passed and skilled labor is plentiful, the tendency is to let down on the efforts to train men which were inaugurated during the busy years, although there is far more time now available for work of this character.

Anyone can see how such a policy will affect the supply of our skilled workers in future years, and the executives of large concerns should push their training schools and apprenticeship courses. If they have none, let them give some of the time they can easily spare at present to making plans for such courses. Where there is a group of smaller shops it would be easy to establish one school for the entire number.

Young men who have been occupied as unskilled workers during the past six years and are eager to increase their earning capacity should be welcomed and taught as carefully as if there existed today the urgent demand for skilled labor which until recently handicapped every manufacturer. In a few years these men will be the skilled workers of our industries and constitute an asset of almost untold value, upon which the whole machine tool building trade will have an equal claim when our shops again resume their former operation.

The Present Situation and the Outlook

SAILING THE BUSINESS SHIP ON A STORMY SEA

By HENRY M. LUCAS, President, Lucas Machine Tool Co., Cleveland, Ohio

To think of a business as a ship sailing the seas is helpful now and then. A ship, to make a successful voyage on a stormy sea, must be sound and well handled. It is essential to have the right size cargo—balanced and trimmed; the machinery must be well cared for, the boilers kept clean, the engines well oiled and adjusted, and run at the right speed consistent with the amount of coal in the bunker and the distance to port. Then the captain must know what course he is steering and not change his mind too often on the way. We would rather take chances of successful passage on a small ship properly equipped and managed than on a leaky old derelict many times as large.

In our opinion, the machine tool business is not the business for the "opportunist," as some who might qualify for that title are now finding out. It is a business better suited to the steady, consistent "plugger," who has faith in himself and in his product and in the very definite service he can render. It is unfortunate that the latter type is so little appreciated and given so little support in times like the present. It is therefore up to him to so manage his affairs that he can survive so as to be on hand when his service is needed and wanted again.

In these timely letters representative men in the machine tool field express themselves on today's problems. The general outlook in the industry is considered, special attention being given to such important subjects as: Co-operation in the Industry, the Necessity for Statistical Information, Importance of Being Ready for the Return of Business, Quality versus Price, and many other problems now facing the machine tool industry. The letters have the definiteness characteristic of the practical business man, and contain the constructive thought and business advice now so much needed.

THE PRESENT SITUATION

By WINSLOW BLANCHARD
President, The Blanchard Machine Co.
Cambridge, Mass.

In regard to the future of the machine tool business, it seems to me that we have about struck the bottom and should experience a slight improvement from now on, but I do not look for anything but dull business for at least the remainder of this year. It will probably be many years before we can have the volume of business that we had in 1917, 1918, and 1919. The influence of the buyers' strike is still with us, and seems likely to prevail until the buyer is convinced that prices have reached the low point and that any changes will be in the direction of higher prices.

We should not, however, forget that in the long run everything points to the continually increasing use of machinery to replace manual labor in the factory, on the farm, and in the household. In the long run this calls for an increasing amount of machine tools, and the machine tool industry is always certain of its place in the economic structure.

MOST PRESSING NEEDS OF INDUSTRY

By HENRY D. SHARPE, President and Treasurer, Brown & Sharpe Mfg. Co., Providence, R. I.

Depression in the machine tool industry is only one symptom of the readjustment going on following the world upheaval of the last seven years. Generally speaking, its period of duration will depend upon world conditions for which we have no adequate measure. In particular, the great activity of the business during past years has been due, among other things, to three great factors—the abnormal preparation for war on the part of the nations; the industrial activity of the western European nations, creating the mass of our own foreign trade; and the repeated upbuilding of the automobile industry. We do not believe the trend of world affairs will permit the resumption of the first factor, while the second should gradually be resumed, and as for the automobile industry, our belief is that its progress is by no means at an end, but will be resumed with advantage to the machine tool industry.

In our opinion, the most pressing needs for the industry are the effecting of economies in our organizations, the still further perfection of design, and an unfailing confidence in its ultimate future following readjustment when the resumed demand for things mechanical will inevitably be felt. This is no time for discouragement as to the future. The present depression is no more or no less than is shared by industry in general.

MACHINE TOOL PRICES

By J. P. BROPHY, Vice-president and General Manager, Cleveland Automatic Machine Co., Cleveland, Ohio

Much has been said about the advisability of reducing machine tool prices. When the price of material and labor advanced during the last few years, machine tool manufacturers naturally found it necessary to advance prices periodically to meet the increased cost of material and labor, in order to keep the returns from their business on approximately the same basis as they were before the war. Few machine tool builders raised their prices beyond this point. This means, of course, that they are not able to lower prices at the present time to any appreciable extent, except as they are forced to do so by the action taken by some of their competitors. Reducing prices at this time will not improve business. As I have often stated in my talks to men in the trade, we have increased our prices from time to time as the cost of labor and material fluctuated, and prices were raised only enough so that our net earnings from our product would be the same as they were previous to the war—that is, we have never attempted to increase the price to the extreme regardless of the number of orders we received. The same holds true of the great majority of the machine tool manufacturers, and their customers are recognizing this fact.

If reducing prices to a minimum would help to a great extent in the return of business, many machine tool builders would probably do so without hesitation in order to move the stock they have on hand, but I am well satisfied that any further reductions at this time are not possible, advisable, or of any value as a business stimulator. Few buyers at the present time question the price of well-known machine tool builders, because they know that their prices were not unduly increased during the war period; and at no time before the war was the price of machine tools excessive, especially when compared with the earnings of many other lines of business. Of course, there are some types of machine tools that were increased more than others, and in those cases corresponding reductions have already taken place.

USING THE PRESENT TIME TO BEST ADVANTAGE

By WINTHROP INGERSOLL, President, Ingersoll Milling Machine Co., Rockford, Ill.

I agree with those who believe that industry has taken a turn for the better. Perhaps this is not so in the machine tool branch of industry, because the machine tool industry always has been the last to pick up after a depression. We realize, too, that machine tools are only a minor branch of the whole. I agree also that before long there will be a turn toward considerably better conditions. Just when this "before long" will come I am not predicting. It will not be a great detriment to the machine tool builders if this period of depression, or non-productive period, lasts for several months longer. We all need a period of quietness in which we can check over our designs and our methods of manufacture. The turn is coming. How far off it is for machine tool builders I would not attempt to say. A few more months of quietness will not hurt us in the least.

It is not at all cheering for any manufacturer to walk through his plant and see two-thirds of his equipment idle. It, perhaps, is less cheering to see a large number of men being laid off, who are just reaching a period where they are interested in their work and of value to the institution. However, this quiet time has compensations. The machine tool builder who is not looking into the possibilities of specializing on some class of tools which is going to decrease the cost of production is losing a great opportunity. Increased production is obtained principally by or through efficient machine tools, designed for single-purpose work. It is most likely that this thing has made itself evident to all machine tool builders. Big opportunities are not far off for the machine tool builder who has a line of machines for intensive production, because when the tide turns, it will be on greatly reduced cost. Machine tools are a large factor in cost reduction.

LOOKING FORWARD TO BETTER BUSINESS

By A. R. STEDFAST, Secretary, Hill, Clarke & Co., Inc., Boston, Mass.

My opinion is that the lowest point of business was reached last February, and that while there has been but slight improvements, we are gradually getting into better shape and looking forward to real improvement being manifested about August, with probably gradually increasing activity commencing in October. The last three months of this year will probably be fairly good months in the machinery line. Beginning in January, 1922, I am looking forward to good, normal, healthy business, which will probably last for several years.

As New England felt the depression first, no doubt this part of the United States will feel the improvement before the rest of the country. Inquiries are being received by us, which are very encouraging, and some sales are made. Our customers need machinery, so let us go and get the business.

WHAT THE FUTURE PROMISES

By B. B. QUILLEN, President and General Manager, Cincinnati Planer Co., Cincinnati, Ohio

We may not have any more wars during our time, and we don't want any more, even though we never build another machine tool. A good healthy, sensible business that takes care of the normal requirements of our people is what we want and is what we are going to have in the near future.

The railroads haven't bought any shop equipment to speak of for twenty years—they must buy very shortly. Our shipyards will soon be more active than ever before and will be constant buyers of tools. The truck business is still in its infancy, and will develop by leaps and bounds very shortly, and require millions of dollars worth of machine tools. We might say the same about tractors; they are an absolute necessity in modern farming, and the time is not far off when horses will be as much of a curiosity as a buffalo.

Thousands and thousands of miles of new and improved highways are now in contemplation and in process of building, which will require road-building machinery in great quantities, and these manufacturers will have to buy machine tools in the same proportion. Better roads mean more automobiles, and more automobiles mean more machine tools.

And there is the airplane, every bit as far along in development and usefulness as the automobile was twenty years ago. Everybody wants to fly, we want to move faster, we want to cross the Continent in twenty-four hours, and we will do it some day; so I think the airplane has a great future and will create another big field for machine tools.

Don't overlook the thousands of new devices that are being invented every year to replace hand labor, such as office appliances, household conveniences, sporting goods, toys, etc., all of which require machine tools in great quantities. In short, no improvement nor progress can be made in the world without the use of machine tools, and no one will believe that the human race is going to stand still very long.

Due to the war there may have been created more machine tool manufacturers than are needed to supply the demand for a long time to come, but that is a condition that can and will be remedied; some will be wise enough to get out of the business, others will consolidate, still others will sell out equipment and reduce their capacity, and a few will be unfortunate enough to be forced out. After this elimination has been completed, there will be a good steady business for those who remain, and as to who shall remain and who shall go is not for me to say, but unconsciously and automatically, we are already going through a weeding-out process.

I have been in the machine tool business for thirty years, have seen its ups and downs periodically, but I have never lost faith in the industry, and to those who can hold out through this readjustment stage I would say: "You are sure to find some good picking in the sweet bye and bye."

VALUE OF STATISTICAL INFORMATION

By ERNEST F. DUBRUL, General Manager, National Machine Tool Builders' Association, Cincinnati, Ohio

Secretary Hoover is quoted as saying, in effect, that "if all the facts can be gathered and studied, any problem can be solved." Many industries that were greatly affected by war conditions now face serious problems of readjustment. The machine tool industry is one of these, and realizing its condition, it has seriously buckled down to the arduous duty of gathering facts to help it solve its problems. Valuable statistics are now being compiled which show the economic situation in various economic cycles in the past. When these figures are complete, the machine tool industry need not go blindly into the future, as it of necessity would have to do if its past course were not pretty well illuminated. With no knowledge of present trends and developments of machine tool demand, the individual can only grope along in the light of his own limited experience. But when the total combined experience of all is made available by a well organized statistical service, each individual can set his own course much more safely than he could without such service.

Machine tools were so necessary to the national defense during the war that anything the industry can do to maintain a sound basis of free, well-informed competition will redound to the nation's benefit in any future emergency. But if the industry did not take stock of itself, and study out the safe course to pursue, the war reaction could easily end in disaster on such a scale as to deprive the country of very necessary facilities if another emergency arose.

QUALITY VERSUS PRICE

By A. H. INGLE, President, Betts Machine Co., Inc., Rochester, N. Y.

The relation of quality buying versus price buying to the present commercial situation is clearly shown by the position in which some manufacturers in the general industrial field now find themselves. In an effort to adjust their prices down to a point where their product will sell, a great many manufacturers already have sacrificed largely if not all their previous profits, and today they are studying in a most careful manner methods of reducing cost of production and the adjustment of overhead.

It is probable that if more careful study had been given the subject of quality versus price before buying production equipment, such as machine tools, the situation so far as they were concerned would be materially improved. They would not now be handicapped by machinery that produces only two-thirds or perhaps one-half as much as it ought to, while the operators' wages, cost of power, floor space, and other fixed charges remain substantially the same.

In buying raw materials, and certain finished products as well, price may well be the first consideration. But in buying a machine tool you are buying an intangible something known as production. Production such as you can buy in a machine tool is a combination of four very important factors—correct design, best material, first-class workmanship, and accuracy. Correctly proportioning these factors will produce what is known as a high-grade machine and one which can be depended upon for production. It is therefore economical to buy on a basis of quality rather than on a basis of price.

It isn't what is in a cheap suit of clothes that makes it cheap. Similarly it isn't what is in a machine tool that makes it cheap. *It's what isn't in it.* It isn't what is back of business today that is responsible for the present state of affairs. It is the confidence which is temporarily not back of it.

The situation today in some ways is even more difficult than that following the Civil War, because we are dealing with a world condition, not a domestic situation, and because our economic machinery is more intricate and less easy to adjust so that it will run without friction. However, we have much upon which to congratulate ourselves. Our difficulties are dwarfed in comparison with those of Europe. The danger point of a great crisis has been passed. The strength of our financial system has been proved, and we have passed safely through a commodity crisis without a panic. We have had a remarkably small ratio of failures. I am convinced that fundamentally we have turned the corner, and that before many months we will have the definite evidence of another era of prosperity. Perhaps the pessimists of today will then appreciate how much more fortunate we are and have been than other countries.

ENCOURAGING FOREIGN TRADE

By O. H. BROXTERMAN, President, John Steptoe Co., Cincinnati, Ohio

My ideas as to what may be done toward securing foreign trade are governed entirely by four principal factors: (1) Rate of exchange and duty on machines imported in the country with which we want to do business; (2) amount of credit and the terms of payment that we are willing to extend to the foreign country; (3) free lighterages and lower ocean rates from this country; and (4) ability to correspond in foreign languages, especially in the Spanish-speaking countries.

First: Everybody realizes that the exchange rate is a serious handicap, which will be overcome only when we become a purchasing agent as well as a selling agent. This is best illustrated by the fact that during the war, while we were purchasing raw materials and food supplies from some of the South American countries, the peso of these South American countries was at a premium, and as a consequence our trade in machine tools was very good and remained so until the American dollar was at a premium. Then all purchases of American machine tools ceased, and this business is undoubtedly now being turned over to some of the European countries where buying can be done on more favorable terms. It appears that the tariff is another serious obstacle. I am advised that in some countries the duty on machinery is being raised to almost a prohibitive level, so that it will be impossible to sell American machine tools there.

Second: Under the heading of credits, it is evident that we are going to be compelled to discontinue our method of demanding cash in New York. We must not only extend to the reliable foreign purchaser such credits as are usually allowed in America, but we must also compete with the manufacturer of machine tools in foreign countries in the extension of such credits as foreign manufacturers may be willing to allow.

Third: The transportation of goods from the factory to the foreign destination must be done promptly and at the lowest possible rate. We must therefore secure lower freight rates from the factory to the seaboard, with free lighterages and low ocean rates, so that our goods may be delivered to the purchaser at the lowest possible cost.

Fourth: Correspondence in foreign languages, especially in Spanish with the Spanish-American countries and Spain, together with literature printed in Spanish, is almost absolutely necessary.

THE INFLUENCE OF FEAR IN BUSINESS READJUSTMENT

By F. O. HOAGLAND, General Manager, Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Eliminating all the causes of the present business depression which have previously been brought up, such as the war, the labor situation, over-production, banking facilities, etc., my opinion is that the real reason is plain *fear*. There is a lack of confidence between individual men, between classes, between the people at large and the administration, and also between nations, and one *fears* what the other is going to do next.

If a man does not have more than one dollar and he does but the fundamental basis is that he is *afraid* to invest or spend his money, because he does not have full confidence in the man he is dealing with, and the only remedy I know not see where the next one is coming from, he is very apt to hesitate about spending it; he may call it waiting for prices on labor and material to come down or what not, for this is *time*.

After a great loss, whether it is a member of your family or part of your savings, you feel it very keenly immediately after it happens, and for some time afterward; but after awhile it will wear off and the pangs are felt less keenly—you gather yourself together, and proceeding with caution you are soon back to your old strides again.

I know of specific cases where money is available for purchasing commodities, but the decision to buy is being delayed, waiting for prices to come down, sufficient confidence not being placed in the seller's statement that prices have reached rock bottom—*fear* again of having to pay a higher price than the goods may be bought for later.

The machine tool industry is, as usual, the last to be affected by the return of good times, and unless the machine tool builders can devise improved machinery for manufacturing purposes which would plainly prove to the user that even with the present limited production he cannot afford to go along without them, it is apt to take some time yet before conditions within the machine tool industry return to normal.

When a man is under the influence of *fear*, his brain does not function normally and his planning ability is affected; this is a sufficient reason for ours not working to the best advantage at present.

THE TIME TO BRING EQUIPMENT UP TO DATE

By AUGUST MARX, Vice-president, The G. A. Gray Co., Cincinnati, Ohio

We feel that the present pause in industry affords an excellent opportunity to make plans for the future. The world demands cheaper but not inferior products. As far as the manufacturer is concerned this means greater economy in production.

How is this to be brought about? Surely not by using slow and inefficient tools, even though they may be low in first cost. Surely not by using tools whose output, even if satisfactory in quantity, is so inferior in quality that it must be improved or corrected by subsequent operations. To our mind the situation demands tools so simple, quick, and convenient that every moment of the operator's time will be utilized to the utmost; so high in quality that subsequent corrective hand operations, such as filing, scraping, fitting, etc., will be reduced to a minimum.

This is the time to bring one's equipment and methods up to date. The manufacturer who does that most effectually will have least cause for worry in the days of hard competition now pending.

GENERAL OUTLOOK IN THE INDUSTRY

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

I believe there will be very little activity in the machine tool business this summer, with perhaps a small improvement late in the fall; but I believe that in about a year from now business will be on a very sound basis, and will gradually reach normal by that time.

Our biggest customer—Europe—is not in a position to buy for some time to come, and we will have more severe competition from Germany than ever. France has always been a good and reliable customer of the United States, and the sooner she gets what is due her, the sooner she will be able to buy. And if Germany is made to pay what she should, she will have to charge more for machinery than she does now; therefore, the market price for machinery will not be so demoralized as at present.

All the European countries can only improve their condition by being busy, and if they are busy they will need machine tools. Nobody is in as good a position to furnish machine tools as the United States, with the exception of Germany. The recuperation of Russia, I believe, will be very slow; therefore, any business from that source cannot be counted on in the near future, but when it comes, I believe it will be of very large volume.

If it is possible for the United States to free the railroads from all the shackles that now hold them down, and put them on a sound basis, this will help the machine tool industries in this country more than any one thing that I can think of. The railroads, as well as any other industry, must be run on business principles and not by labor unions.

Prices of goods cannot be reduced until the cost is reduced, and no investments will be made in the industries unless there is a fair assurance that the industries will not be hampered by labor unions and government interference. People with capital are today investing their money in foreign and domestic government and municipal bonds and other securities of this kind.

In the meantime the machine tool builders, in particular, should devote as much time as possible to improvements in their designs and methods of production. If the machine tool manufacturers devoted more time and money at present to these things, rather than putting up a big stock which will eat itself up in interest, they would be far better off when business comes back, as it will then stay good for a long time.

The American machine tool industry has grown up, not on account of price but on account of superiority in design. The best European machine tool builders are the best imitators of the United States products, and it is by being a lap ahead that we have been able to hold the supremacy in foreign markets. I believe this position is as vital today as ever it was.

To sum up, I believe there will be a gradual revival in business in the fall, and that a year from now the purchasing power of Europe may be enough improved to make machine tool business in the United States about normal.

BEING READY FOR THE RETURN OF BUSINESS

By E. A. MULLER, Vice-president and Manager, The King Machine Tool Co., Cincinnati, Ohio

The principal requisite to a resumption of business in our industry today is confidence, and therefore we are rearranging our factory, repairing such tools as require attention, making new jigs and fixtures, and with the business that is coming to us at the present time we are able to employ about two-thirds of our regular force full time. A recent visit to quite a number of factories situated in various parts of the country has disclosed that needed repairs to buildings and equipment are being withheld until there is a demand upon these plants. We think this is a great mistake.

The history of business has taught that there are periods of depression in almost every decade; therefore, the present situation is not an unusual one, although the necessity for deflation in prices injects a more uncertain factor than has obtained in any period of depression since manufacture has become as important as agriculture in this country. There is no doubt in our minds that it will be a long time before all the plants equipped to build machine tools are filled to capacity with orders; but as all industry has to some extent over-expanded as a result of the war, it will obviously be unwise to expect 100 per cent activity for several years.

COOPERATION IN INDUSTRY

By OGDEN R. ADAMS, Rochester, N. Y.

In my article on "Better Relations between Machine Tool Manufacturer and Dealer," published in the April number of MACHINERY, I mentioned three distinct periods in this relationship, namely, prosperity, restlessness, and readjustment. Prosperity has taken flight; restlessness is still with us, because it is closely identified with, and part of, the readjustment period.

This latter period is now fully upon us; there is no question about it, and it is not at all to our liking. We much prefer the period of prosperity, when orders come easier, and there is not so much worry or work. But the readjustment makes us work, and think, and concentrate hour after hour. We knew it was coming, having been duly warned of its approach by precedence, but we did not want it.

Prices have dropped very greatly on machine tools, which has meant a loss to both manufacturer and dealer—to the manufacturer because he paid the highest prices for material and labor, and to the dealer because he purchased at high prices, and must sell at a distinct loss. Both alike have suffered—manufacturer and dealer—which forges another link between them, and forms a potent mutual reason for cooperation. The word "cooperation" has grown in importance during the past three months, and is demonstrating its value in industry as never before. In fact, only by cooperation during the present period can either manufacturer or dealer hope to withstand the storm of the readjustment.

The manufacturer may cooperate with the dealer in various ways, namely, by standing back of him in his endeavors to stimulate and encourage sales; by giving sufficiently liberal discounts to insure a living wage; and by giving moral and mechanical support. Let us not at this time forget that we are in a basic, and therefore, a most dignified business—one which the world absolutely requires; and let us remember that both manufacturer and dealer in our industry are in a position to help to restore a prosperous era.

THE FUTURE OF THE MACHINE TOOL INDUSTRY

By C. L. Libby, Vice-president and Superintendent, International Machine Tool Co., Indianapolis, Ind.

In relation to the future of the machine tool industry in general, it seems that unless we can find some foreign market as an outlet we can expect no industrial boom in the near future, as the capacity of our machine tool plants is far in excess of our requirements.

After the war was ended, the large manufacturers of war material had a great supply of worn out and abused machines which they unloaded on the market. These were largely purchased by people who were starting into business or by smaller concerns who thought they were getting a bargain. For this reason, it would seem that when business picks up, it will be necessary for the large concerns to buy considerable new equipment.

In going through the country and visiting the different shops, we find that a large number of the concerns which manufacture in large quantities are waking up to the fact that special machines and special tools will give them a much larger output per man-hour—sufficient to warrant the purchase of new and improved equipment. We have in the last six months made more estimates and time studies than at any period of our existence, which indicates that manufacturers have plans for the future and are waiting for a favorable outlook to place orders for equipment.

If the railroad trouble can be settled, it will mean an outlet for a large amount of equipment which is badly needed. Conditions are such that if one large industry like the railroads starts buying, it will start up a number of other industries. So far as the machine tool business is concerned, it is the writer's opinion that the improvement will be gradual and that it will take some time before we get back to normal.

SIGNS OF THE RETURN OF ACTIVITY

By W. C. Acklin, Secretary and Treasurer, Acklin Stamping Co., Toledo, Ohio

It looks as though the worse part of the depression has passed. We are not expecting a rush of business, but for the last six weeks our shop has been operating six days a week. When we first started working full time we doubted our ability to continue, but since that time we have put on more men and each succeeding week has seen work for a few more employes than the preceding week.

Like everyone else we have had time in the last few months to rearrange machinery, go over our methods of production, etc., so that we will not use any of the wasteful methods that were forced upon us during peak production, and because of our reduced costs we have gotten in touch with new lines that would not have been possible twelve months ago.

VALUE OF COOPERATION

By N. P. LLOYD, Sales Manager, Newton Machine Tool Works, Inc., Philadelphia, Pa.

When it seemed that the thirteen American Colonies would be unable to cooperate in forming the United States, Franklin is credited as saying, "Gentlemen, we must all hang together, or else, most assuredly, we shall all hang separately." Machine tool manufacturers can best "hang together," I believe, by one of the following methods:

1. Voluntary syndicates of non-competing lines, permitting individual ownership or decentralized control.

2. Consolidation of companies of non-competing lines of which there might be two or three such consolidations, providing centralized control through a holding company similar to the "steel corporation," such consolidation to be effected by (a) uniform method of appraisal establishing sound values; and (b) present owners accepting securities of the consolidated companies.

Either method would accomplish the following: (1) Control of sales at less expense, giving better service and closer contact with user. (2) Standardization, overcoming multiplicity of designs and overlapping of sizes, including interchange of facilities for special parts, and perhaps, centralized manufacture of small parts now purchased. (3) New developments at a minimum of expense through wider application. (4) Uniform accounting methods preventing sales at less than cost. (5) Financing by group method, which would be easier than by the several units; this includes individual plant financing, as well as the financing of orders, particularly for complete installations.

The British Machine Tool Makers, Ltd., is one recent effort to create a voluntary syndicate. Under the German laws, I understand trade syndicates are compulsory. These two countries are our principal competitors in foreign trade, and it would appear that if they recognize the value of cooperation, we should at least investigate its possibilities.

If there is the will to cooperate and improve the business of the machine tool industry, I believe either plan suggested would prove highly successful and beneficial.

IMPORTANCE OF TRADE ANALYSIS

By CHARLES D. OESTERLEIN, President, Oesterlein Machine Co., Cincinnati, Ohio

Ignorance of important facts as they exist and lack of appreciation of their proper co-relation costs more money, more misery, and more lives than civilization should be willing to pay, and our greatest problem at all times is to gather, co-relate, and disseminate such facts among the masses as will reduce friction, discomfort, and losses.

Employes should understand many of the problems of employers, who, in turn, should understand all of them themselves. Graphical statistics compiled by the Government, showing relative costs of commodities delivered to foreign markets from the United States, as compared with those from competing nations; living conditions here and in competing countries; something of the distribution of gross profits by industries from experience records, etc., would prove of inestimable assistance. Further, without driving home reliable knowledge of relative economical conditions in competing foreign countries, as compared with our own there will not be the kind of effort made by labor nor by management to make for a continuation of our prosperity.

HOW TO AID THE RETURN OF BUSINESS

By C. E. BILTON, President and General Manager, The Bilton Machine Tool Co., Bridgeport, Conn.

The inquiry as to how to expedite the return of business activity is a hard question to answer. One viewpoint is this: If Bridgeport and the other greater and lesser manufacturing centers would get down to bed-rock prices and then convince the retailers that the bottom had been reached, the wheels of industry would again begin to turn. The retail stock in our mercantile establishments is extremely low, and our merchants naturally will not buy in more than hand-to-mouth quantities until satisfied that price-cutting is at an end. Depleted shelves will not bring back normal orders until accompanied by the conviction that price deflation is a thing of the past.

Every merchant knows just as well as the manufacturer that further reductions are coming. The fact has been published far and wide that the cost of living has fallen a greater percentage than wages.

Each manufacturer can help expedite the return of business activity by putting his own house in order. The disagreeable obligation of forcing wages and prices to a practically permanent low post-war basis must be fulfilled before quantity buying will be resumed. Scolding the retail merchant (who is a distributor) for not stocking up has not helped and will not help the situation.

I have only touched upon one minor phase of this great problem, but I am convinced that the establishment of rock-bottom prices would expedite the return of prosperity.

TAKING STOCK OF EQUIPMENT AND METHODS

By FRED ROSS EBERHARDT, Manager Gear Department, Newark Gear Cutting Machine Co., Newark, N. J.

Business is not made by a "feeling of optimism," nor is it possible to "restore confidence" by talking about it. There are an infinite number of small things all of us need, and many things are cheaper to buy than to do without. Whenever we buy anything that benefits us, we help to keep business moving.

The present lull gives us all a chance to find out how we stand. Some find that the unusual times swelled their organizations to unwieldy proportions, and a few plants have grown to such size that the normal demand for their products could not begin to keep them busy. Now is the time to compare one's production capacity with one's probable share of the normal demand. This may mean the sale of buildings or equipment for some, while many will find their plants not equipped well enough.

Very often when a new machine is needed, and apparently there is no place to put it, one can make room by scrapping some old type machine that has outlived its profitable years. In gear-cutting machines, for example, an old type gear-cutting machine may be cutting about one gear in the time it takes a new modern machine to cut three. This holds equally true of many other types of machine tools.

Some of the men are working better since there are more men than jobs. This is only human nature, and we cannot blame them any more than we could help their taking it easy during the war and afterward, when there were more jobs than men. With trouble makers kept out of the shop, there is no labor problem. The only problem is to keep enough work so that the men will be kept busy.

Some of our friends will not buy anything now, no matter what it is. But they make a mistake. Of course, prices will come down a little more, but that is nothing to worry about. If you need something, buy it and benefit by it as soon as possible. By improving your own tools and methods you can reduce your own prices a little. This may induce somebody to place an order. You may find, on careful study, that your product bears the burden of a lot of unnecessary expenses which can be done away with. Then you can make your prices commensurate with cost of manufacture, plus a reasonable profit.

Urgent questions confront the manufacturer of machine shop equipment today. Ever on the alert, always leading instead of following, ceaselessly improving their products, and forever inventing machines and accessories, American manufacturers have earned and achieved an enviable position in all countries. In the world-wide mechanical market, greatly changed by the war, wholly new conditions exist at home and abroad. It may be as hard to hold what was won as it was to achieve it. There is no question of the necessity for making greater efforts than ever before, and of the need for all the resource, inventive ability, and enterprise that our manufacturers and selling organizations command.

PREPAREDNESS SHOULD BE THE WATCHWORD

By C. W. BETTCHER, Sales Manager, H & G Die Head Works of Eastern Machine Screw Corporation, New Haven, Conn.

We believe that the words of Charles M. Schwab, "Now is the time for the business man to concentrate attention on the cost sheet and not on the profit statement," should be given serious thought by every executive. We have passed through a period where any old tool or method that would turn out something to meet the unprecedented demand, regardless of its efficiency or the quality of the work it produced, was put to work. We are now entering upon a period of competitive production in which the fittest to survive will be those that produce either a better quality of product for a given price, or by their efficient tooling a product at a lower price, or both. The present depression provides the opportunity much desired to test, without interference of forced production, such tools as may in the future be the deciding factor in reduced expenses of manufacture and improvement in the quality of the work, or both. Such tests should be regarded as a far-sighted policy, without which an enterprise cannot expect to weather the ever-changing business conditions from decade to decade.

The present depression worries should not be allowed to cloud the fact that everyone knows that good business must come back. It always does, and with the added zest of competition. Those who have been far-sighted enough to prepare for most efficient manufacturing in the future will reap their reward. In times of depression prepare for that healthy and fierce competition that must eventually follow.

THE INCREASING SCARCITY OF SKILLED WORKERS

By A. W. FORBES, Manager, Forbes & Myers, Worcester, Mass.

The controling factor in the machinery and machine tool fields will be the available supply of skilled workers. We have seen and must expect to continue to see a great decline in the ability of the men in this field. Our colleges are being thoroughly advertised. They are collecting the best of the young men of the country and making of them professional men, salesmen, engineers, etc. The college and technical school graduates will not consider the operation of a machine as a life work, even if the pay and degree of skill required are both greater than in the clerical jobs they are able to secure. There seems to be no prospect of changing this tendency.

This change in the character of the men must increase the demand for fool-proof machinery. To an increasing extent the machines must be such that they can be operated without requiring much of either brains or muscles.

We should abandon hope of improved labor conditions until the job of foreman is made the equal of that of lawyer, both in compensation and in social prestige. With the elimination of the best from the ranks of the workers, it is going to require an increasing degree of skill in the management from the top to the foreman. Even with this added attraction to the job of foreman, it is doubtful if the supply of available material will be sufficient to produce a reasonable number of foremen of suitable caliber.

MAIN CAUSES OF THE PRESENT DEPRESSION

By ARTHUR BROCK, Jr., General Manager, Arthur Brock, Jr., Tool & Mfg. Works, Philadelphia, Pa.

The present business depression is due to a variety of causes for which there is no single cure. There isn't any doubt that the relative basis of values in decreasing the purchasing power of the agricultural population has a material effect on the situation. There is also no doubt that a business revival is retarded more by other considerations, especially by the destruction of capital by Legislative and governmental interference in the questions affecting the values and purchasing power of the railroad and public utilities. This last consideration has gone far to make increased capital for manufacturing extremely difficult to obtain, and the manufacturers of production equipment are all suffering from a lack of orders due to this cause.

There isn't any doubt that the machinery business in its various branches should be very busy to meet the competition of cheap labor in Europe, and even if owing to the business depression it is not possible to place orders immediately, the machinery business will profit greatly by a campaign to increase production by new equipment later.

The Odontometer for Testing Gear Teeth

By EARLE BUCKINGHAM, Engineer
Pratt & Whitney Co., Hartford, Conn.

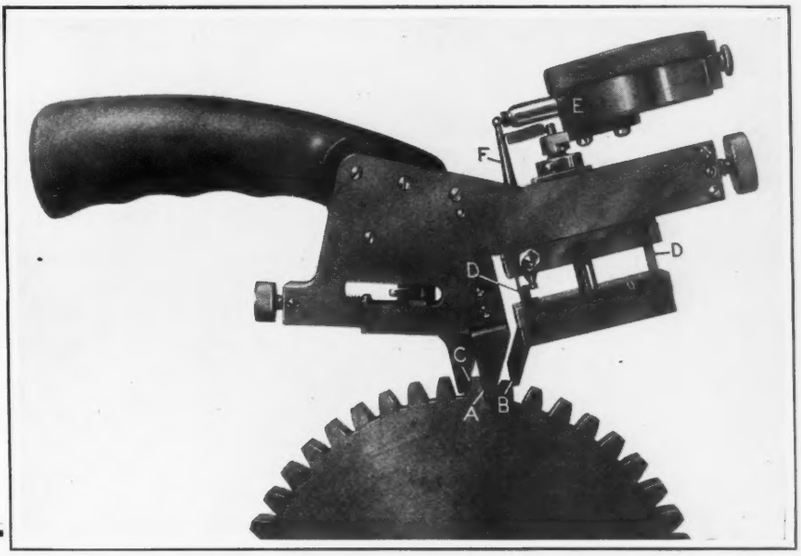


Fig. 1. Odontometer applied to a Spur Gear for testing the Profiles and Spacing of the Teeth

THE satisfactory testing of gear tooth profiles, spacing, etc., is one of the most difficult of inspection operations. Many devices are at times employed. First, there are gear tooth calipers, and gear-testing machines which hold the gears at fixed center distances and merely test, in effect, the thickness of the teeth or the amount of backlash. These machines show only whether or not the gears will run together without interference. When testing gears at fixed center distances, an experienced operator can detect errors in form or spacing which prevent the gears from running smoothly, but he only knows that such errors are present and can tell nothing about their exact nature and amount.

Second there are various forms of involute testing devices. These are invaluable for the diagnosing of the various errors in both the profile and spacing of gear teeth, but they are primarily laboratory instruments. Special disks, representing either the base circle or the pitch circles or ratios, must be used in conjunction with them. Furthermore the actual pressure angle employed may vary appreciably from the theoretical pressure angle specified. In the majority of cases this is of little importance, provided the actual pressure angle is the same on all gears that mesh together. Uniformity rather than absolute accuracy as regards this factor is the essential consideration. Therefore if base circle disks are employed, such gears will show an error in profile when tested, although they may run together properly. In order to determine this point definitely, the size of the base circle disk which would show a true, or a practically true, involute would have to be determined experimentally, and the base circle disks of the two mating gears changed proportionately.

All the foregoing testing instruments have their proper place, and are of importance in the testing of involute gears, yet there has been need for a simple and self-contained instrument or gage for testing the accuracy or uniformity of gear tooth profiles and spacings of the teeth in production work. It was to meet this need that the odontometer here described was developed by the Pratt & Whitney Co., Hartford, Conn. It is equally adaptable to spur and helical gears, is fully self-contained, has a range of from 3 to 10 diametral pitch, may be used to check any pressure angle, and can be applied to a gear while it is in place in the machine. An instrument of larger size is now under way for testing the teeth of gears ranging from about ¾ to 4 diametral pitch.

Construction of the Odontometer

The odontometer is shown in Fig. 1, as used to test a spur gear. In effect it is composed of a section of a straight-sided rack with two parallel effective faces, one being fixed and the other movable. A third face, set at an angle to the two working faces, is used to hold the fixed working face in contact with the flank of the gear tooth. The fixed registering surface is at *A*, and the movable indicating surface at *B*. The third surface *C* holds surface *A* in contact with the involute surface of the gear tooth. The surfaces *B* and *C* are adjustable so that gears ranging from 3 to 10 diametral pitch can be tested with the same instrument.

The indicating surface *B* is mounted on two thin flat springs *D*, which act as pivots, free from backlash. The dial indicator *E* is actuated by the lever *F*, which has a ratio of 5 to 1, so that each division on the dial represents a movement of 0.0002 inch of the indicating surface *B*.

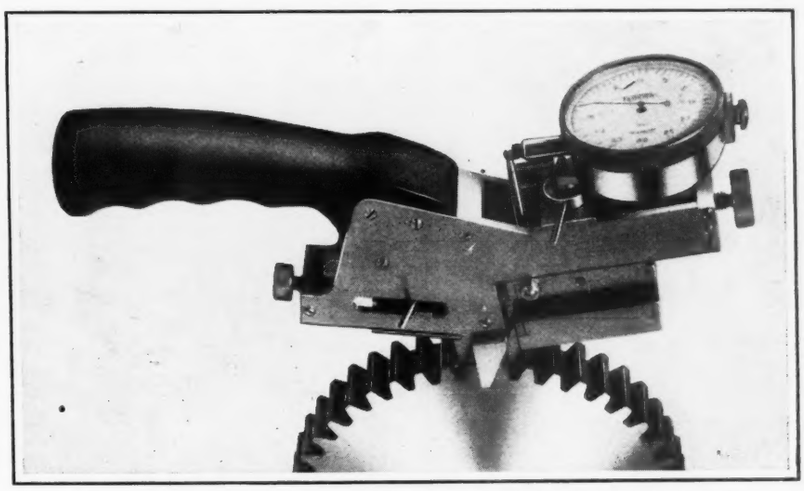


Fig. 2. The Indicator of the Odontometer shows Profile Errors and Any Variation in the Normal Pitch

Operation and Use

In order to explain the operation of this instrument, it is necessary to consider some of the characteristics of the involute profile. In Fig. 3 is shown a series of involutes, equally spaced on a given base circle. The distance *a* between these involutes along a line tangent to the base circle is always the same, no matter where the tangent is drawn.

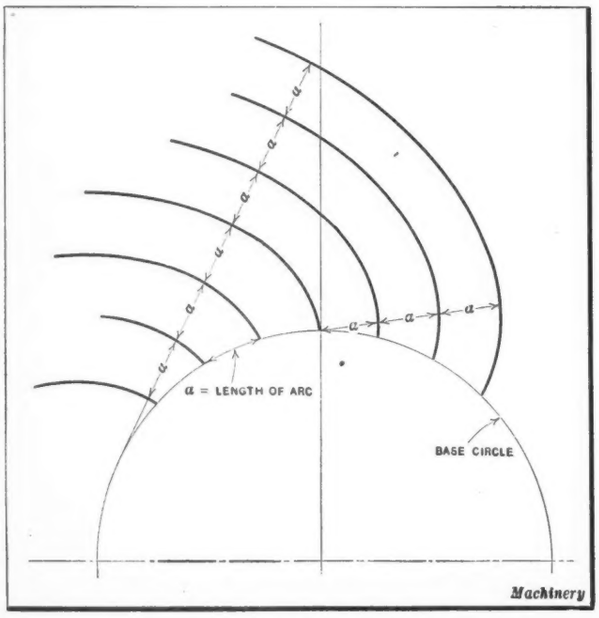


Fig. 3. The Odontometer checks the Uniformity of Dimension a between Successive Involutes at Different Tangential Positions

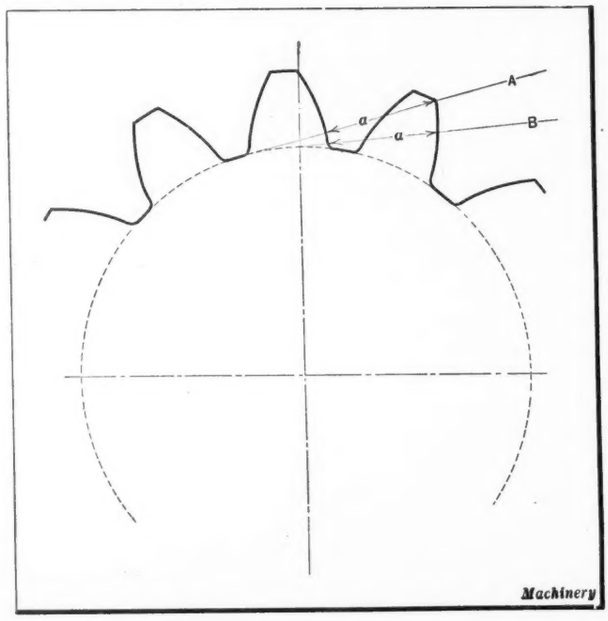


Fig. 4. That Part of the Gear Tooth Profile between the Lines A and B is tested by the Odontometer

This distance a is equal to the length of the arc of the base circle intercepted by two successive involutes. The odontometer measures this distance a. In testing any pair of profiles, if this distance does not remain constant, it indicates an error in the involute profile. In testing successive pairs of profiles, if the distance a does not remain uniform, it indicates an error in the spacing.

Fig. 4 shows a few gear teeth, and indicates the portion of the involute which the odontometer actually tests. It will be noted that this does not cover the entire involute flank of the tooth. The instrument is located over one tooth and rocked into contact with the adjacent tooth. When the movable face of the instrument reaches position A, the distance a should be registered. This distance should be constant until the instrument reaches the line B. Although the instrument only tests the accuracy of the involute profiles on the "overlapping" portions, these portions are the most essential for quiet and smooth running. Experience will soon show how much variation can safely be allowed on either the profile or spacing before noticeably noisy gears result. Thus a definite inspection tolerance can be established for any class of gears.

In general, the instrument is used as a comparator, to test the uniformity of interchangeable and mating gears. If actual measurements are required, the distance between the two parallel working faces of the instrument can be measured. Then, if a record is kept of the variation on each tooth, the value of this measurement between the parallel faces, multiplied by the number of teeth in the gear, corrected in accordance with the variations on the successive teeth, will give the circumference of the actual base circle of the involutes.

The instrument is made so that the dial indicator is in full view of the operator as he rocks it into the teeth, as shown in Fig. 2. The weight of the instrument is so disposed that it rocks of its own weight into the second tooth. The handle is used only to steady the instrument and not to exert any pressure on it. The face of the fixed parallel rack tooth is made of liberal width to square up the instrument. The instrument can be adjusted quickly from one

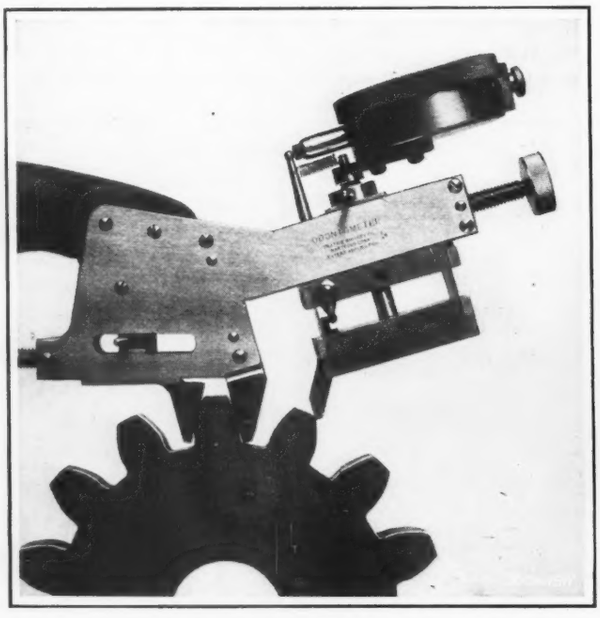


Fig. 5. Odontometer adjusted for testing Gear of Larger Pitch than that shown in Fig. 1

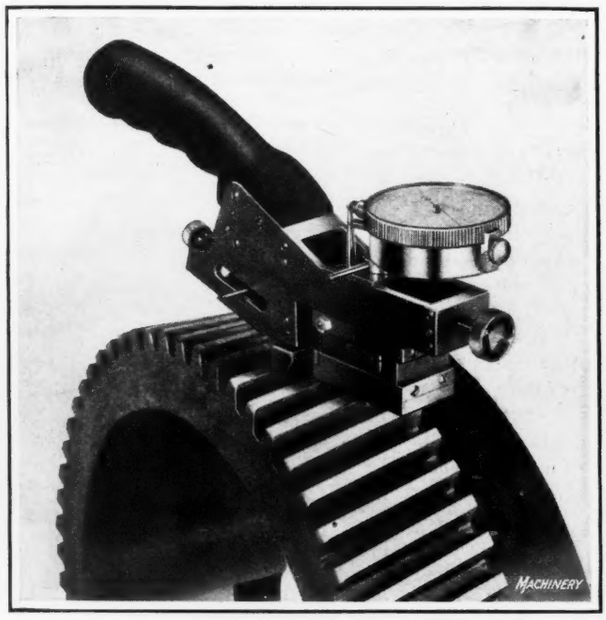


Fig. 6. The Odontometer may be applied to Helical Gears as well as to Spur Gears

pitch to another. Fig. 5 shows it set for a gear of larger pitch than that in Fig. 1. Fig. 6 shows the odontometer employed to test a helical gear. Its operation here is identical to its operation on a spur gear. Such an instrument will prove invaluable in testing the uniformity of the teeth of herringbone reduction gears which are to operate at high pitch-line velocities.

* * *

SPEEDS OF GRINDING WHEELS

In general, a soft grinding wheel revolving rapidly permits a higher production than a hard wheel revolving more slowly, according to an article by W. T. Montague, published in *Grits and Grinds*. This is true because the more open structure of the soft wheel provides greater clearance for the grinding chips, which results in a freer and cooler cutting action. Theoretically, therefore, the correct speed for grinding wheels is the safe maximum speed at which the wheel may be operated. In actual practice, however, certain ranges of peripheral speed have been found to give good results on certain classes of ground work. For example, a satisfactory wheel speed for sharpening wood-planer knives is around 3500 surface feet per minute; for off-hand snagging of castings, 5500 surface feet per minute; for cylindrical grinding of crankshaft pins and bearings, around 6000 surface feet per minute; and for cutting off hardened and high-speed steel, tubing, and the like, the proper speed approximates 9000 or 10,000 surface feet per minute.

In surface grinding, lower wheel speeds are used than for cylindrical grinding, because mechanical limitations usually prevent the work-table being traversed fast enough to keep the wheel face opened up and free-cutting; but, generally speaking, certain grits and grades of grinding wheels operating under these speed conditions have given satisfactory results.

It is generally thought that the faster a grinding wheel revolves, the greater its productivity in a given time. This is not altogether true in precision operations, as in cylindrical grinding for instance. It is only true to a limited extent in off-hand grinding, such as the snagging of castings. In cylindrical grinding, the production of a given wheel is determined by the depth of cut, the table traverse, and the diameter of the work. Hence, the controlling and limiting factors are the rigidity and general sturdiness of the grinding machine to permit deep cuts, and the traverse speeds of the table or wheel, if the wheel-head travels instead of the work-table. Increase of wheel speed in cylindrical grinding changes the size and shape of the chips. The rate of production is not greatly affected, unless the higher speed permits the use of a softer wheel, which might cut more freely. But for a given wheel there is no difference in production, whether 4500 or 6500 surface feet per minute is used, provided the grade or the work speed is adjusted to these different wheel speeds.

In off-hand grinding operations, a somewhat different condition is obtained. Here the grinding may be said to be done under constant pressure in contrast to the constant feed in cylindrical grinding just described. For example, if a bar of metal is pressed against a revolving wheel face under a given pressure, it is obvious that the faster the cutting grains come around, the quicker succeeding sections of the bar will be cut away; but, in practice, this is only true up to a certain speed, for if the grade of a wheel is correct for a speed of 5000 surface feet per minute, there will come a point, if its speed is increased, when the wheel face will begin to glaze over, thus reducing its cutting capacity. Nothing is really gained from increasing the wheel speed in off-hand grinding over the generally accepted range, unless wheels softer than those usually recommended are employed; and the extremely severe service to which many wheels are put in off-hand grinding discourages the use of soft grades.

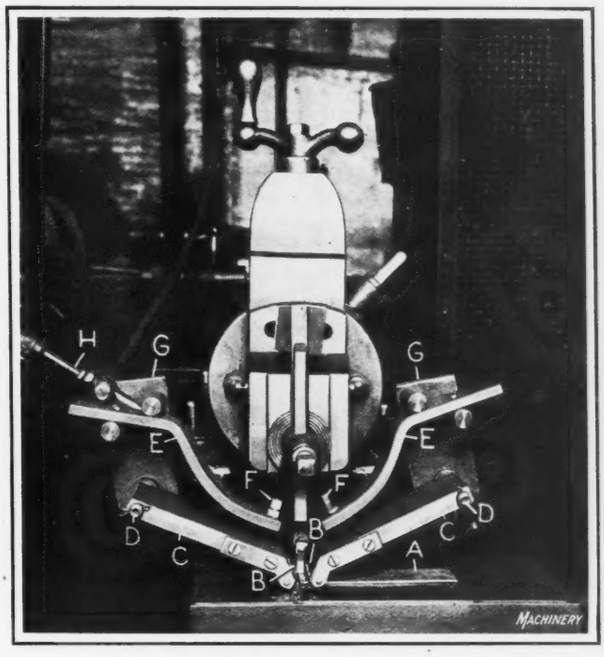
From the foregoing, the following conclusions are reached:

1. The grade of hardness to be recommended for a grinding operation depends on the surface speed of the wheel.
2. The grinding wheel should be as soft as is feasible for the operation, and whenever possible operated at the high end of the recommended range of speeds.
3. For a given wheel used for precision grinding operations, not much increase in production is to be expected from increasing the speed of the wheel alone.
4. The logical way to increase production in precision grinding operations is to increase the traverse of the work past the wheel or the depth of cut of the wheel.

* * *

INTERESTING SHAPER OPERATION

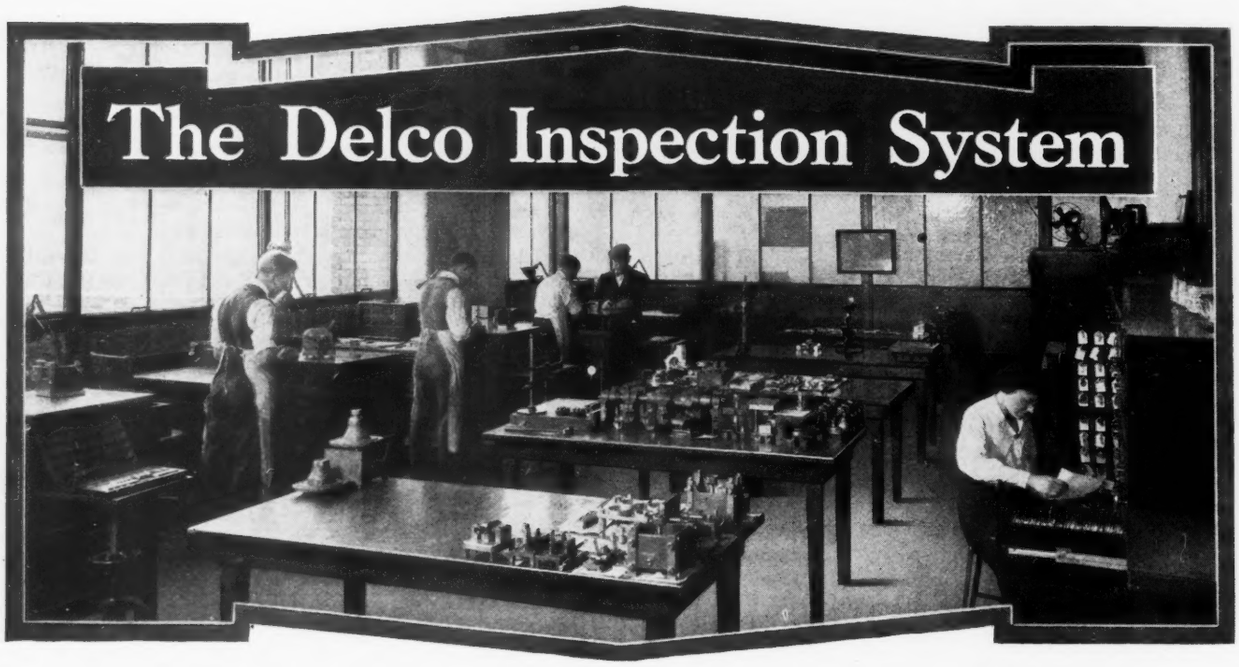
In the plant of the Todd Protectograph Co., Rochester, N. Y., rather an unusual equipment has been provided on a shaper built by Gould & Eberhardt of Newark, N. J., to adapt a machine of this type for finishing the backs of bronze type plates for protectographs. One of these pieces has its back side finished during one pass of the shaper



Interesting Method of holding Work on a Shaper while performing a Finish-planing Operation

table. About 0.020 inch of metal is removed, and the entire back of the work is required to be parallel with the face of the type within 0.001 inch. These pieces of work measure 6 inches long by 1½ inches wide, and with a feed of 1/16 inch per stroke of the shaper ram, the actual machining time is thirty-five seconds. The hourly rate is eighty type plates, making the routine production time forty-five seconds each.

After one plate has been machined, the shaper table is not traversed back to its original position; but with a view to saving time, the direction of feed is reversed so that the next piece can be finished with the table traveling in the opposite direction. Referring to the illustration, it will be seen that the type plate *A* is held down by means of two rollers *B*. Each roller is carried by an arm *C*, these arms being supported on pivots *D* so that pressure applied by spring bars *E* is depended upon to hold the rollers *B* firmly down on the work. Regulation of the pressure is accomplished by means of set-screws *F*, carried at the ends of the spring arms *E*. It will be apparent that the entire work-clamping mechanism is carried by brackets *G*, secured to the shaper column; and the chips are blown away by means of compressed air delivered through a nozzle *H*.



The Delco Inspection System

A Description of the Methods Used in the Tool and Gage Designing Department of the Dayton Engineering Laboratories Co. and the Standards of Gaging Adopted

By ERIK OBERG

IN the June number of MACHINERY the general principles of the Delco inspection system were described. It is evident that with an inspection system which is as carefully planned and worked out as that of the Dayton Engineering Laboratories Co., the system for the designing of jigs, fixtures, tools, and gages must also have been given careful consideration, and everything in connection with this work that permits of standardization has been properly studied and worked out with a view to providing uniformity in the methods used.

Organization of the Tool Designing and Tool Making Departments

The tool designing and tool making departments are under one head, the two departments being classified together under the name "Tool Division" and placed in charge of a supervisor. It is clear that many advantages are gained by having what are ordinarily considered two separate departments under a single head, directly responsible both for the design and the making of the tools. The divided responsibility that results when the tool designing and the tool making are conducted independently is avoided, and the friction often met with when the work is so organized is eliminated.

The Handling of the Tools for New Jobs

When a new mechanism is to be built by the Delco organization, the tool equipment and the gaging system are first definitely determined upon. The drawings for the mechanisms to be built are turned over by the engineering department to the tool designing department. Before any tools are designed, a conference is called at which are present the head of the tool designing department, the machine division supervisor, the head of the routing department, and the foremen of the departments in which the machining of the parts for the new mechanism will be done. At this conference a decision is reached as to the methods by which the various parts are to be machined, the machines that are to be used for the work—depending upon what machines are available and suitable—the order of operations, and the specific tool equipment that will be required, including jigs and fixtures and other special tools, as well as the gaging equipment. When standard gages can be used, this part of the work is taken care of directly by the tool ordering department, while special gages are designed by the tool designing department. In case the gaging equipment is very special and of an unusual nature, the inspection department is also consulted before the actual designs are made. The ordering of standard gages and tools is taken care of by using Van Dyke prints for all standard plug gages, snap gages, etc., on which the tool designing department fills in the required dimensions.

Tool Lists

Before the tools to be used for the parts for certain mechanisms are ordered and before any designing of special tools is done, the proposed tool list is taken by the head of the tool designing department to all the foremen and the inspectors who will have anything to do with the machining

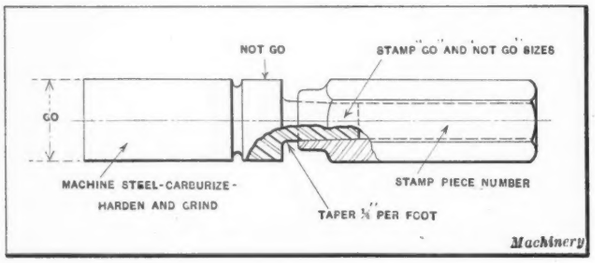


Fig. 1. Design of Single-ended Limit Plug Gages for Sizes up to 1½ Inches in Diameter

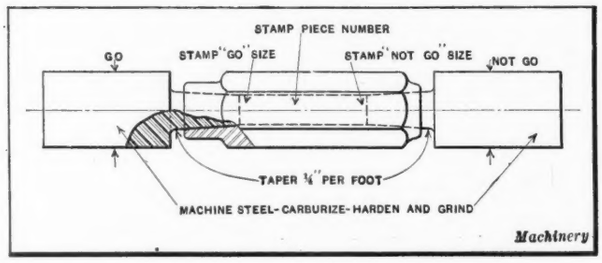


Fig. 2. Design of Double-ended Limit Plug Gages for Sizes up to 1½ Inches in Diameter

or inspection of the parts to be made, in order to determine that all details have been worked out in accordance with the ideas of everyone concerned. The tool list contains at its top the names of all the supervisors or foremen who should be consulted, a typical tool list containing as many as thirty-five names. The general appearance of a typical tool list (without this list of names) is shown in Table 1.

In the first column of the tool list is given the routing number that corresponds to the number on the routing list provided for the manufacturing divisions. The column

TABLE 1. TYPICAL TOOL LIST

Routing No.		Parts to be made and tools used	Department
		Pc. 220 Generator	
100		Use same test fixture as used on 165	Final Insp.
		Pc. 15309 Armature	
2	TN-94002	Dup. Overall Length Gages	R-XE
		Pc. 33322 Rivet No.00 Brown & Sharpe	
155	TN-25856	One circular form tool	S
	TN-94083	Duplicate Gages	S-XS
		Pc. 33323 Screw No.52 Acme	
155		No tools needed as per Mr. Ely	S
		Pc. 33324 Bearing Retainer	
16-132	TN-93973	One progressive die	Q
132-B	TN-93971	One piercing die	Q
75	TN-93972	One forming die	Q
		Pc. 33325 Armature Shaft	
		* 7/16 - 20 U.S.F. Button Dies	
		* No. 29 H. S. drills	
		* No. 5 Woodruff Keyway Cutters	
37	TN-93977	Dup. Gages	L-XL
115-A	TN-93978	Dup. Gages	L-XL
115-B	TN-93979	Dup. Gages	L-XL
51	TN-93981	One Drill Jig	L
120	TN-93980	One Mill Fixture	L
64	TN-93975	Two Set Plugs size .86425	L-XL
	TN-93976	Two Set Plugs size .98385	L-XL
		Other Set Plugs in No.17 Tool Supply	
		Pc. 33326 End Frame	
		* .161 x .250 H.S.S.S. Counterbores	
		* .250 x .406 H.S.S.S. Counterbores	
		* 5/16 x 32 U.S.F. Thread Plugs	
		* No.22 H. S. Drills	
		* 9/32 H. S. Drills	
200-A	TN-94003	One Set of Chuck Jaws	M
	TN-25842	One Set of Tools	M
	TN-94006	One Middle Limit Plug 4.062	M
	TN-94005	Dup. Depth Gages .657 - .662	M-XM
	TN-94004	Dup. Depth Gages .250 - .7485	M
200-B	TN-94007	One Turning Fixture	M
	TN-25843	One Overhanging Tool Holder	M
	TN-94008	Dup. Gages	M-XM
		Plugs will be ordered for bearing hole as soon as new limits are determined by the Engineering Department	
51	TN-94009	One Drill Jig (All Holes)	M
190	TN-94022	One Tapping Fixture	M
		Pc. 33327 Frame	
200 etc.		Use the same tools as Pc. 31731	J
51-B	TN-93974	One Drill Jig (Angular Holes)	J
		Pc. 33330 Washer	
16-132	TN-94084	One Progressive Die	Q
		Pc. 33334 Bearing Retainer	
16		Use same die for Pc.32638 TN-91334	Q
132		Use die for Pc. 32638 TN-91333	Q
		Pc. 33335 End Housing	
200 etc.		Use same tools as Pc. 32639 End Frame	M
51	TN-93983	Add hole in TN-90944 Drill Jig	M
13	TN-93982	One Broaching Fixture	M
		Pc. 33339 Screw (Davenport)	
155		No tools needed as per Mr.J.Kly	S-XS

farthest to the right gives the symbol or designation employed to indicate the different departments in the plant, there being in all twenty-five separate departments thus designated.

It will be seen that the tool list contains a statement not only of such jigs, fixtures, and gages as will be required, but also states the sizes of standard drills, dies, cutters, etc., that will be needed. This is done in order that these standard tools may be obtained directly from the stockroom, and an asterisk (*) is used to indicate such standard tools as should be in stock.

TABLE 2. TOLERANCES ON WORKING PLUG GAGES

Tolerance on Product, Equal to Difference between Maximum and Minimum Plug Gage Sizes	Amount that "Go" Plug Gage is over Blueprint Size	Limits to which Toolmakers must work on Gages
0.0005 and under	0.0002	+ 0.00005 — 0.0001
0.0005 to 0.001	0.0003	+ 0.00005 — 0.0001
0.001 to 0.002	0.0004	+ 0.00005 — 0.0001
0.002 to 0.004	0.0005	+ 0.0002 — 0.0002
0.005 or more	0.001	+ 0.0002 — 0.0002

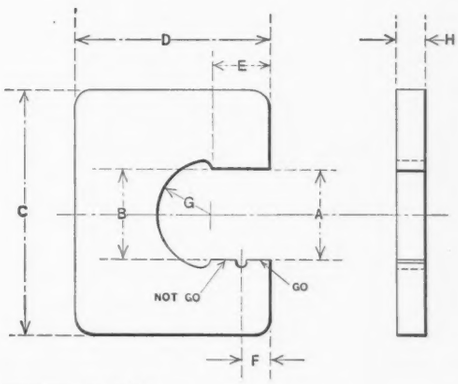
Machinery

By studying the tool list it will be found that in many instances the same fixtures or tools as are used for some other part or mechanism are employed. When no tools are needed for a certain operation, the authority for the statement that no tools are required is generally also included on the tool list, as indicated.

Standards for Gage Design

In the design of gages for the inspection of the product made by the Delco organization, a number of standards have been adopted both for the design of the gages and for the tolerances that should be used in the tool-room in making the gaging equipment. The specific tolerances required on the work or ultimate product are established by consultation between the engineering department, the tool designing department, the machining department, and the inspection department, as these four factors must be brought together in any case when a satisfactory system of tolerances is to be established.

TABLE 3. DIMENSIONS OF SNAP GAGE BLANKS



All dimensions in inches

A	C	D	E	F	G	H
¼- ½	1⅝	1 5/16	½	¼	5/16	¼
½- ¾	2	1⅝	½	¼	7/16	¼
¾-1	2¼	1¾	½	¼	9/16	¼
1 -1¼	2½	2	9/16	9/32	11/16	¼
1¼-1½	2⅞	2¼	⅝	5/16	13/16	¼
1½-1¾	3¼	2 11/16	¾	⅜	15/16	5/16
1¾-2	3 9/16	2 13/16	¾	⅜	1 1/16	5/16
2 -2¼	4	3¼	⅞	7/16	1 3/16	5/16
2¼-2½	4¼	3⅜	⅞	7/16	1 5/16	5/16
2½-2¾	4½	3½	⅞	7/16	1 7/16	5/16
2¾-3	5	3¾	⅞	7/16	1 9/16	⅜
3 -3¼	5¼	3⅞	⅞	7/16	1 11/16	⅜
3¼-3½	5½	4	⅞	7/16	1 13/16	⅜
3½-3¾	5¾	4½	1	½	1 15/16	⅜
3¾-4	6	4⅝	1	½	2 1/16	⅜
4 -4¼	6¼	4¾	1	½	2 3/16	⅜

Machinery

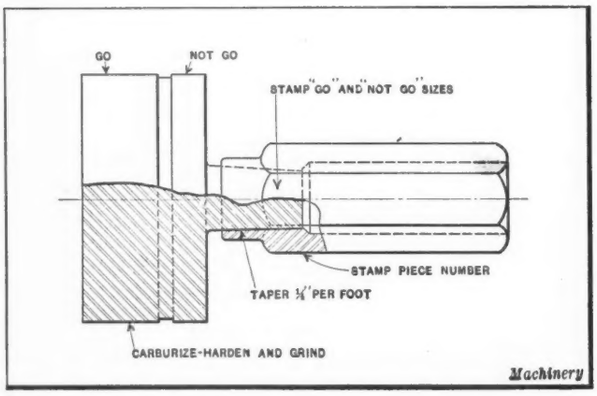


Fig. 3. Single-ended Limit Plug Gages for Sizes between 1½ and 4½ Inches

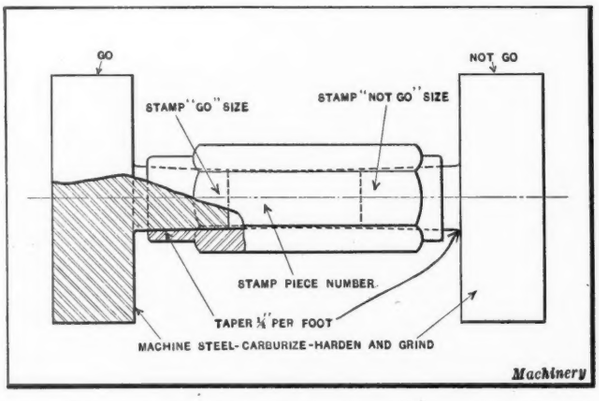


Fig. 4. Double-ended Limit Plug Gages for Sizes between 1½ and 4½ Inches

In addition to the tolerances on the work to be made, which determine the maximum and minimum limits on the gages, there must be tolerances established for the tool-room, as the gages themselves cannot be made absolutely to maximum or minimum limits, but must also have limits established within which they are to be made. This subject has been carefully considered, and certain limits have been established for the location of holes in jigs and fixtures, for inspection plug gages, for plug gages for the manufacturing departments, for reamers and reamer bushings, and for studs; these limits are given in the following:

Tolerances for Tool-room Work

The tolerances established for the location of holes in jig and fixture work are plus or minus 0.0005 inch for dowel holes, plus or minus 0.0015 inch for tapped holes, and plus or minus 0.005 inch for holes in which the mating part is not expected to have a close fit. Different limits are given the tool-room for inspection plug gages and for plug gages used in the manufacturing departments, because by having the limits in the manufacturing departments such that whenever the work has passed the manufacturing gages it is always certain to pass the inspection gages, a great deal of controversy and loss of time is avoided.

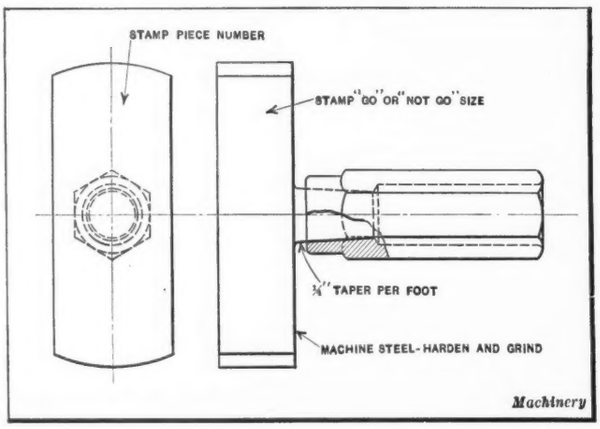


Fig. 5. Design of Plug Gages for Sizes Larger than 4½ Inches

Inspection Plug Gages—When the tolerance on the work—that is, the difference between the maximum and the minimum plug gage sizes—is 0.001 inch or under, the tool-room is required to finish both the maximum and the minimum plug to the size given on the blueprint with a limit of + 0.0001 inch above this size.

When the tolerance on the work is from 0.001 to 0.002 inch, the tool-room is required to finish both the maximum and the minimum plug gages to the size given on the blueprint with a limit of + 0.00015 inch above this size.

When the tolerance on the work is 0.002 inch or more, the tool-room is required to finish both the maximum and the minimum plug gages to the size given on the blueprint with a limit of + 0.0002 inch above this size.

Plug Gages for the Manufacturing Departments—The "Go" plug gages for the manufacturing departments are made to a nominal size which is a certain amount over the size given on the blueprint or over the nominal size of the inspection "Go" plug gage. Table 2 shows both the amount that the "Go" plug gages for the manufacturing departments are made over the size of the inspection gage, and the limits to which the toolmakers must work on the gage.

In making plug gages, a distinction is made in the handles so that an inspection gage may be easily distinguished from one used in the manufacturing departments. The inspection gages are provided with hexagon handles, while the manufacturing gages are provided with knurled handles.

Tolerances for Reamers

When limits for the dimensions of reamers are stated as ± 0.0005 inch, the desired size is 0.00025 inch under the maximum limit.

When limits for the dimensions of reamers are stated as ± 0.001 inch, the desired size is 0.0005 inch under the maximum limit.

When limits for the dimensions of reamers are stated as ± 0.002 inch, the desired size is 0.001 inch under the maximum limit.

All reamer bushings are made as nearly as possible 0.0002 inch over the size of the reamer.

Tolerances on Locating Studs

On all locating studs on jigs and fixtures made for parts in which the hole is to be ground, an allowance must be made for the amount left for grinding. In addition, the studs should be a certain amount smaller than the minimum limit of the hole, the following allowances being made:

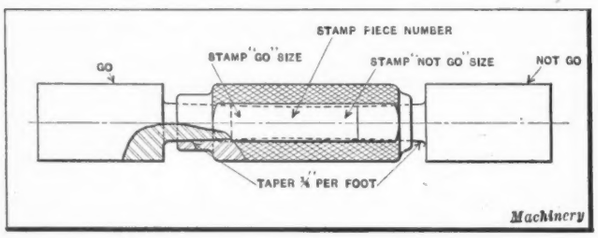


Fig. 6. Design of Manufacturing Gages with Knurled Handles

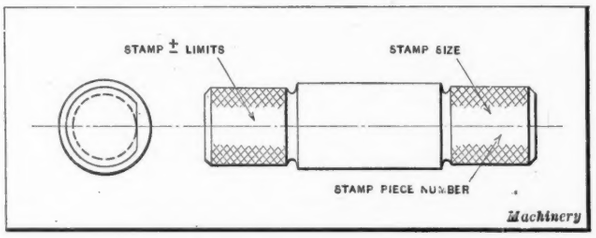


Fig. 7. Special Plug Gage for setting Indicating Gages

0.0005 inch on studs up to ½ inch diameter;
0.001 inch on studs up to 2 inches diameter;
0.002 inch on studs larger than 2 inches in diameter.

Design of Gages

The accompanying illustrations show the design of plug gages of different sizes. Fig. 1 shows the design used for plug gages up to 1½ inches in diameter with the "Go" and "Not Go" gages at the same end of the handle. Fig. 2 shows double-ended limit gages for sizes up to 1½ inches. Fig. 3 shows single-ended limit gages for sizes larger than 1½ inches, but less than 4½ inches; and Fig. 4 shows the design of double-ended limit gages for the same range of sizes. Fig. 5 shows the design used for plug gages larger than 4½ inches in diameter. In this case the gage is always made single-ended, two separate gages being made, one for the "Go," and one for the "Not Go" limits.

The gages shown in Figs. 1 to 5 inclusive have hexagon handles and are inspection gages. The design of the manufacturing gages is the same as for the inspection gages, except that the handle is knurled, as indicated in Fig. 6. On the double-ended limit gages the lengths of the "Go" and "Not Go" plugs are made the same, because in this way there is an opportunity to grind down the "Not Go" plug to the "Go" size, if it should be found desirable to do so.

Special plug gages are used for setting indicating gages. These are designed as shown in Fig. 7 with knurled ends and with the gage portion in the center.

Snap gages with the "Go" and "Not Go" steps on the same side of the gage are shown in Table 3, where the general dimensions for gages of this type are also given. Gages of this design are made for gaging dimensions of from ¼ to 4¼ inches.

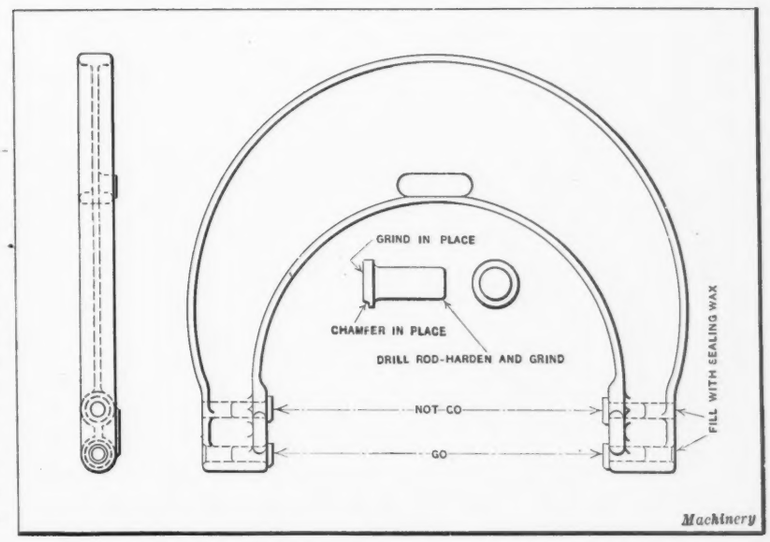
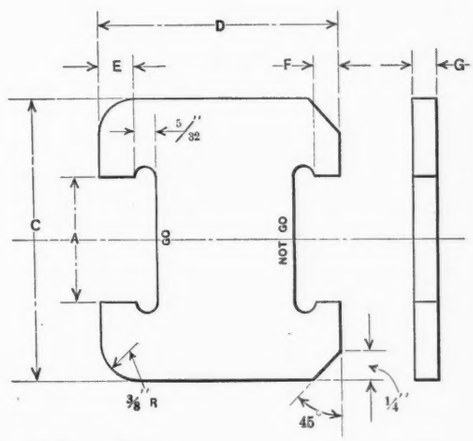


Fig. 8. Design of Limit Snap Gages for Dimensions from 2 to 8 Inches

Snap gages with the "Go" and "Not Go" gaging spaces on opposite sides of the gage are made for dimensions from ⅛ to 6⅛ inches, and are shown in Table 4 together with the general dimensions used.

Snap gages with the regular snap gage frame and with inserted gaging points are made to the design shown in Fig. 8. Gages of this type are made for gaging dimensions from 2 to 8 inches.

TABLE 4. DIMENSIONS OF SNAP GAGE BLANKS



All dimensions in inches

A	C	D	E	F	G
⅛– ½	1¾	2¼	9/32	7/32	3/16
½– ⅞	2⅛	2¼	9/32	7/32	3/16
⅞–1¼	2½	2¼	9/32	7/32	¼
1¼–1⅝	2⅞	2¼	9/32	7/32	¼
1⅝–2	3¼	2¼	9/32	7/32	¼
2 –2⅜	3⅝	2½	11/32	9/32	¼
2⅜–2¾	4	2½	11/32	9/32	¼
2¾–3⅛	4⅜	2¾	13/32	11/32	¼
3⅛–3½	4¾	2¾	13/32	11/32	5/16
3½–3⅞	5⅜	2¾	13/32	11/32	5/16
3⅞–4¼	5¾	2¾	13/32	11/32	5/16
4¼–4⅝	6⅛	2⅞	15/32	13/32	5/16
4⅝–5	6½	2⅞	15/32	13/32	5/16
5 –5⅜	6⅞	3	½	15/32	⅜
5⅜–5¾	7¼	3	½	15/32	⅜
5¾–6⅛	7⅝	3	½	15/32	⅜

Machinery

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FIRST APPLICATION OF COMPRESSED AIR TO POWER PRESSES

A rather humorous anecdote is related concerning what is claimed to be the first time that compressed air was employed to eject work from a power press. A young fellow applied for a job as a die-setter in a power-press shop of considerable size, and was engaged on the strength of the glowing capabilities he claimed for himself. The first task given him was to set up and try out a die for stamping a simple circular blank of very light metal, and he was given the choice of two presses for the purpose. Both presses were small and of equal capacity, but one was of the straight-sided type, while the other was an inclinable press. He chose the latter for the work. The boss kept his eye on the young die-setter because, from a previous inspection of the construction of the die, he knew that the stamping would not lift out and slide away from the press of its own accord, even though the machine was inclined at a generous angle.

When the die had been set up and was tried out, the result was not as the die-setter expected, but, of course, as the boss had anticipated—the work would not slide off the die. The young fellow seemed puzzled for a minute; then his worried look changed to one of hope and understanding. He left the press for a few minutes and returned with a hand bellows. This he gave to his helper and stationed the latter in a sitting position on the floor and under the press. The helper was then instructed to place the nozzle in a vent in the bottom of the die and to squeeze hard immediately after each tripping of the machine. The helper followed the instructions faithfully and the stampings kept flowing out of the die and rolling from the press after each operation. Thus, the young genius not only made good on his new job, but also instituted the first compressed-air device for the removal of small stampings from a press, even though it was operated by a "human knock-out."

N. T. T.

Graphical Determination of Shaft Diameters

By N. BARNES HUNT, Engineer, U. S. Reclamation Service, St. Ignatius, Montana

THE combinations of torsion and compression and torsion and tension in shafts are treated in various ways by designers. One of the most satisfactory methods is to apply the true-stress theory, in which stress is assumed to be a function of deformation.

Torsion produces a shearing stress which may be considered in combination with either the flexural compression or the flexural tension. Since the compressive and tensile strengths of steel are approximately equal, and the flexural compressive and tensile stresses are equal, it is customary to consider only the combination of torsion and tension, knowing that by so doing the requirements for compression will be satisfied.

The accompanying diagrams give the diameters of solid round shafts for various loads, the curves being plotted in accordance with the true-stress theory. The diagrams have been prepared for the low working stresses of 10,000 pounds per square inch in tension and 8000 pounds per square inch in shear, but by means of the accompanying table of coefficients, the diameters may be determined for other working stresses. It is customary to place a greater restriction on stresses in shafts than in members not subject to variable stress.

The diagrams are based on formulas taken from the author's article "Practical Applications of the Combined Stress Theory," which was published in August, 1919, MACHINERY. These formulas are:

$$D^3 = \frac{32R}{\pi S_t}\left(M_b + 2\sqrt{M_t^2 + M_b^2}\right) \qquad (1)$$

$$D^3 = \frac{64R}{\pi S_s}\sqrt{M_t^2 + M_b^2} \qquad (2)$$

in which

D = diameter of shaft in inches;
S_t = true unit tensile stress;
S_s = true unit shearing stress;
R = Poisson's ratio;
M_b = bending moment in inch-pounds;
M_t = torsional moment in inch-pounds.

Formula (1) gives the shaft diameter for tensile stress, and Formula (2) for shearing stress.

A not uncommon conception of combined stress is that the elementary stresses form a single stress for which the member must be designed. The facts are, however, that torsion increases the tensile stress and that tension increases the shearing stress resulting from torsion, so that the stresses must be considered separately. Similarly, in the diagrams the tension curves must be considered separately from the shear curves, and the diameter to be used will be the greater of the diameters found. It will be noted that the solid lines give the diameters for tensile stresses, and the broken lines those for shearing stresses. It is apparent that the controlling stress is determined by the relative magnitude of the bending and torsional moments.

The value of R (Poisson's ratio), that was taken in preparing the charts, was 1/3. By the process of interpolation the diameters of intermediate sizes of shafting can be obtained, if desired, to a sufficient degree of accuracy.

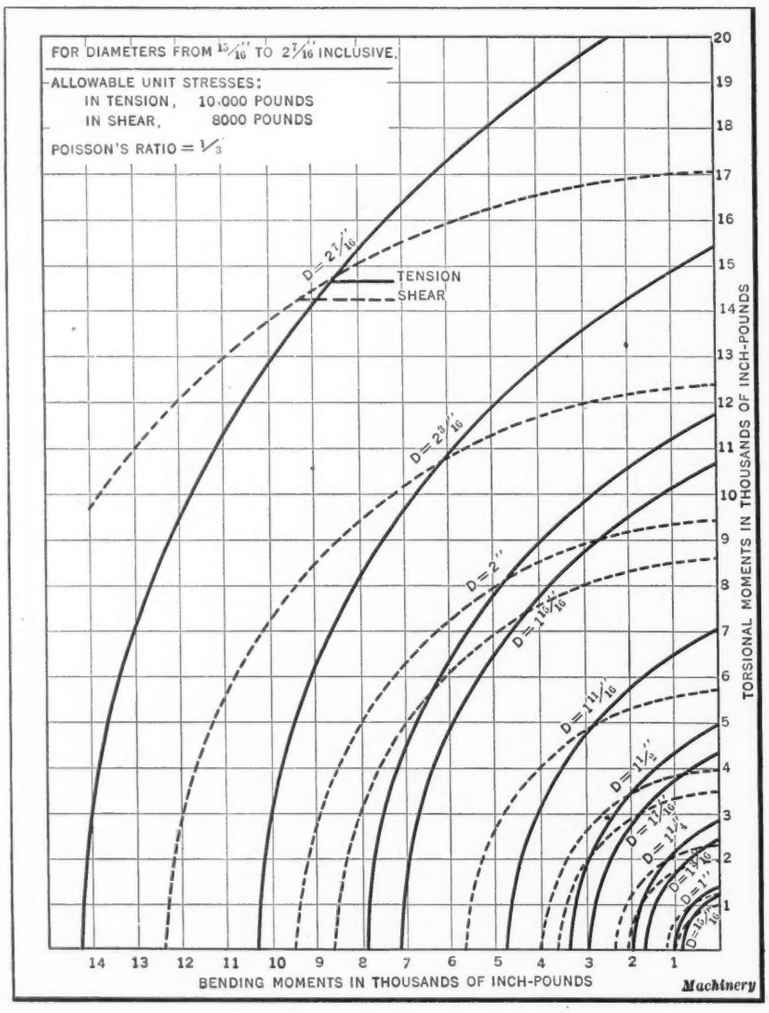

Fig. 1. Chart for graphically finding the Proper Diameters of Shafts subjected to Combined Tension and Torsion—Sizes from 15/16 to 2 7/16 Inches, Inclusive

Examples of the Use of the Charts

Example 1—The bending and torsional moments in a shaft are, respectively, 20,000 inch-pounds and 60,000 inch-pounds. Allowing stresses of 10,000 pounds per square inch in tension and 8000 pounds in shear, what should be the diameter?

Referring to Fig. 2, it is seen that for tension (solid lines), the coordinates intersect at a point which practically lies on the curve for a 3 11/16-inch diameter shaft. Considering shear (broken lines), the diameter is found to lie between 3 11/16 and 3 15/16 inches. The 3 15/16-inch diameter shaft should be used.

Example 2—Find the proper diameter of shaft, using allowable stresses of 12,000 pounds per square inch in tension and 9500 pounds in shear, for the moments given in Example 1.

Referring to the table of coefficients, $D = 0.94 \times 3.6875 = 3.47$ inches, which is suitable for a shaft when under a tension of 12,000 pounds per square inch. Interpolating between the coefficients for 8000 and 10,000 in the table to obtain the proper value for an allowable shearing stress of 9500 pounds per square inch, and also between the shaft diameters 3 11/16 and 3 15/16 in Example 1, $D = 0.95 \times 3.77 = 3.58$ inches, for shear. In this case a 3 11/16-inch diameter shaft should be used.

TABLE OF COEFFICIENTS FOR VARIOUS WORKING STRESSES

Kind of Stress	Allowable Unit Stress in Pounds						
	6000	8000	10,000	12,000	14,000	16,000	18,000
Tension	——	1.08	1.00	0.94	0.89	0.85	0.82
Shear	1.10	1.00	0.93	0.87	0.83	0.79	——

Machinery

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INVESTIGATION OF ELECTRIC ARC WELDING OF STEEL

The United States Bureau of Standards has made an investigation of the properties of arc-fused metal. The complete report on the investigation, prepared by Henry S. Rawdon, Edward C. Groesbeck, and Louis Jordon, is given in Technologic Paper No. 179 of the Bureau of Standards. Briefly stated, the report reaches the following conclusions:

A fusion weld is fundamentally different from all other types in that the metal of the weld is essentially a casting. The arc-fusion weld has characteristics which are peculiar to it alone. A knowledge of the mechanical properties of the arc-fused metal which is added during the process of welding is fundamental in the study of arc-welding. The mechanical properties, as revealed by stressing in tension, were determined by testing specimens (0.505 inch diameter and 2 inches length) cut from blocks of arc-fused metal prepared under conditions similar to those met with in welding. Additional specimens were also prepared by expert welders outside of the bureau and submitted for comparison with those prepared by the bureau.

Two types of electrodes—a "pure" iron, and a low-carbon steel—were used. During fusion the composition changes considerably as the carbon and other elements are eliminated. The two types of electrodes become very much alike in composition. In each case a considerable percentage of nitrogen is taken up. The mechanical properties of the arc-fused metal as measured by the tension test are essentially those of an inferior casting. The most striking feature is the low ductility of the metal. All of the specimens examined (about seventy) showed evidence of unsoundness in their structure, tiny enclosed cavities, oxide inclusions, and lack of intimate union. These appear to be a necessary consequence of the method of fusion as now practised. They determine almost entirely the mechanical properties of the metal. The observed elongation of specimens under tension is due to the combined effect of the numerous unsound spots rather than to the ductility of the metal. The material is, however, inherently rather ductile, as may be shown by the changes produced in its microstructure by cold-bending.

A characteristic feature of the microstructure of the arc-fused metal is the presence of numerous microscopic plates within the ferrite grains. These persist in the metal upon prolonged heating; for example, six hours at 1000 degrees C. in vacuum was not sufficient to remove them. The various lines of evidence available indicate that they are related to the nitrogen content of the metal. The microscopic examination indicates that there is but little, if any, relation between these so-called "nitride plates" and the path of rupture produced by tensional stresses. The effect of the grosser imperfections of the metal is so much greater than any possible effect of these plates in determining the mechanical properties, that the conclusion appears to be warranted that this feature of the structure is a matter of relatively minor importance in ordinary arc welds.

Judged from the properties of the metal after fusion, neither type of electrode used appears to have a marked advantage over the other. The use of slight protective coatings on the electrodes does not appear to affect the mechanical properties of the arc-fused metal materially in any way. The specimens were prepared in a manner quite different from that used ordinarily in electric arc welding, and so do not justify specific recommendations concerning general methods to be employed in welding practice.

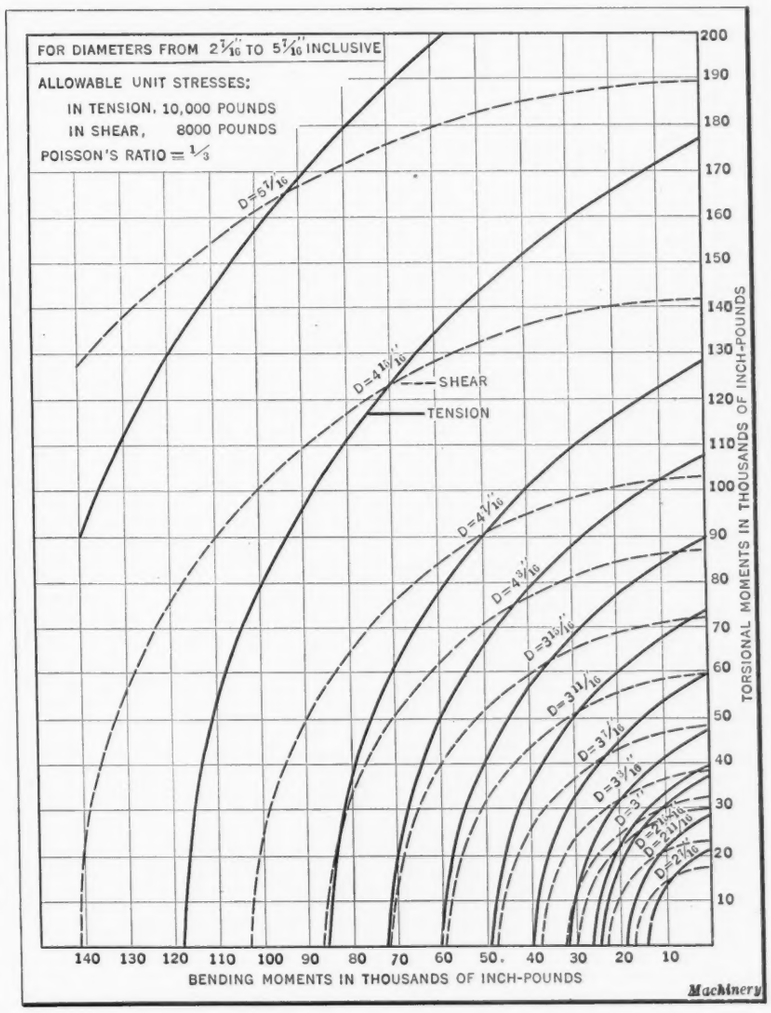

FOR DIAMETERS FROM 2 7/16 TO 5 7/16 INCLUSIVE
ALLOWABLE UNIT STRESSES:
IN TENSION, 10,000 POUNDS
IN SHEAR, 8000 POUNDS
POISSON'S RATIO = 1/3
D=5 1/16
D=4 15/16
SHEAR
TENSION
D=4 1/16
D=4 9/16
D=3 15/16
D=3 11/16
D=3 1/16
D=3 3/16
D=3
D=2 13/16
D=2 11/16
D=2 7/16
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
TORSIONAL MOMENTS IN THOUSANDS OF INCH-POUNDS
140 130 120 110 100 90 80 70 60 50 40 30 20 10
BENDING MOMENTS IN THOUSANDS OF INCH-POUNDS
Machinery

Fig. 2. Chart for graphically finding the Proper Diameters of Shafts subjected to Combined Tension and Torsion—Sizes from 2 7/16 to 5 7/16 Inches, Inclusive

PORTABLE ELECTRIC RIVET-HEATER

An electric rivet-heating apparatus, self-contained in a small wooden box, which is mounted on rollers so that it can be readily moved about the shop as required on various jobs, is illustrated in Fig. 1. This equipment was developed

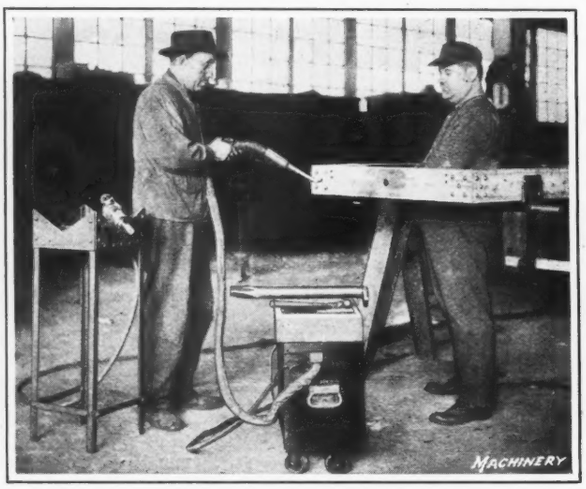


Fig. 1. Heating Rivets by inserting them in Members to be assembled and placing Electrodes in Contact

several years ago in the shops of the Commercial Truck Co., Philadelphia, Pa., for use in constructing the electric motor trucks manufactured by this concern, and has rendered such satisfactory service that several more have been built since then. In heating a rivet with this equipment, the rivet is first inserted in the holes of the parts to be assembled, and then, after the electric current has been turned on, a copper electrode or terminal is applied to each end of the rivet, as shown, until it is hot enough for the heading operation, which is performed next. In Fig. 1 a pneumatic riveting hammer may be seen on the stand at the left, ready for use as soon as the rivet has reached the desired condition. A ⅜-inch diameter rivet, 1½ inches long, is heated to the riveting temperature in approximately sixteen seconds.

Alternating current of 220 volts and 60 cycles is supplied to the rivet-heating unit, which contains a transformer that reduces the voltage to 6. From the assembly view of the transformer in Fig. 2, the construction may be readily observed. The primary coil *A* has 156 windings about core *B*, which is made up of a large number of laminated wrought-iron plates, 9¼ inches long and 8⅜ inches wide. No. 9 double cotton-covered wire was used in making the primary coil, a thin sheet of fiber being placed between each layer of windings and the outside of the coil wrapped with fiber and insulating tape. Two copper castings *C* serve the purpose of a secondary coil. Thick sheets of fiber *D* are placed between the adjacent surfaces of these castings and those of the iron core *B* as shown, while other insulation is supplied at *E* and *F*. Thick sheets of fiber are also placed between the primary coil and the iron core.

Two ingoing wires are connected to the primary coil, one through tap *G* and the other through tap *L*, which is connected at the end of the 156 windings of the coil. Tap *H* is connected to the primary coil at the end of 108 windings; tap *I*, at 120 windings; tap *J*, at 132 windings; and tap *K*, at 144 windings. These four taps were only furnished on the original rivet-heater for experimental purposes, because of the lack of knowledge regarding how much the original voltage should be reduced. However, 156 windings proved satisfactory, so that on subsequent equipments, taps *H*, *I*, *J*, and *K* were omitted. Thick sheets of fiber are also placed between castings *C* and the copper details by means of which the wires are connected to the primary coil.

Two flexible cables conveying the current of reduced voltage to the terminals are clamped and soldered in the openings of holders *M* and *N*. These cables are about 6 feet long and are composed of three stranded cables, twisted together and wrapped with insulating tape. The terminals originally used with the equipment were made as shown at *O*, consisting of a copper end held to the end of the flexible cable by means of a set-screw, and a handle made of 3/16-inch diameter wire. Reference to Fig. 1 will show that the terminals now employed are of somewhat different design. The wooden box in which the transformer is contained is completely insulated inside.

* * *

As a result of the experience during the war, investigations were made in Switzerland to determine whether any iron ore is available in that country; the outcome of these investigations was the discovery of an iron ore district containing fifteen million tons of ore, and it is estimated that an additional amount of twenty-two million tons is available. Based upon the pre-war consumption rate, this iron ore should cover all the industrial requirements of Switzerland for forty-five years.

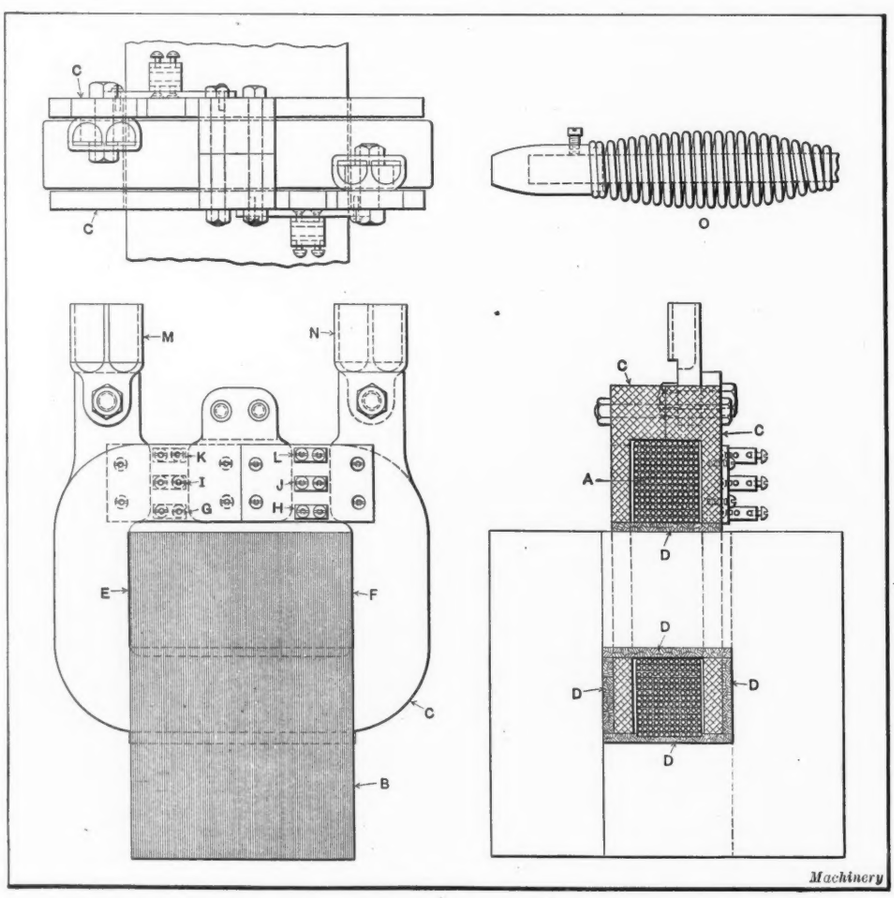
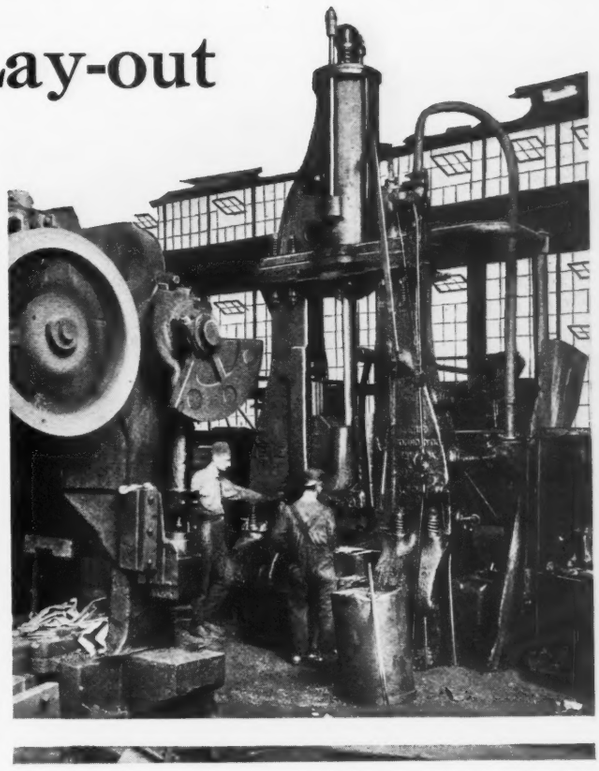


Fig. 2. Transformer used in Rivet-heating Unit to reduce the Voltage of the Current supplied

Drop-forge Plant Lay-out and Equipment

A Model Drop-forging Plant Arranged for Handling Large Quantities of Work



THERE are many angles from which the selection of a proper site for a drop-forge plant may be regarded, and each of these has an important bearing on the efficiency of the plant. Railroad facilities for handling the product; the kind of fuel that can be most readily and economically obtained; the possibilities for extensions to the plant; and the types of hammers to be used—each of these factors should receive due consideration. No rules can be given which will satisfy all the conditions that may be encountered in various localities. For example, there are certain sections of the country where it may be necessary to provide for using both oil and gas as a fuel, while in others an adequate supply of gas is always assured, and the likelihood of requiring the installation of an oil storage plant is very remote.

There are at present in the United States about 135 commercial drop-forging plants, but only a few of these were built complete at one time, so that there is no recognized standard for hammer-shop arrangement. In fact, where a plant has grown to large proportions by additions from time to time, made as the available space would permit, systematic routing of the work is very difficult. A new plant should be laid out to permit extensions as the requirements of the industry demand, without disturbing the remainder of the plant. It is apparent in locating hammers as well as other drop-forge shop machinery, that it should be predetermined whether the material is to travel crosswise of the shop while in process, or in some other way.

While the plan suggested herein provides for installing all types of drop-hammers in one building, some modern plants have other arrangements to best suit local conditions. In one shop, the board hammers and the heat-treating department are in one building, leaving the steam drop-hammers, upsetters, etc., in another, these two buildings running parallel and being separated by an areaway. Another arrangement is the combining of all hammers and forging machines in one shop with a section reserved for blacksmithing, the heat-treating department being housed in a separate building. The drop-forge plant lay-out suggested in this article is based on observations of some of the most modern drop-forging plants in the country, and it is believed that the lay-out shown includes all the best details of construction which have heretofore been incorporated in the more modern drop-forge plants. The lay-out described is intended to refer to a plant with a certain drop-hammer capacity and rated monthly output as specified in the following, and it is assumed that this plant is in an industrial section of the country where it is possible to obtain both oil and gas fuel, and where good railroad facilities are available.

Size and Number of Drop-hammers

An arrangement which has been laid out to take care of a monthly output of 3000 tons of drop-forgings is shown in Fig. 1. A conservative estimate of the number of drop-hammers required in a plant of this size is fifty, and the estimated total falling weight, 150,000 pounds. The expert drop-forger will appreciate the flexibility that any figures relative to capacity must have, because these are contingent upon the size and nature of the product. For example, there are many shops where a 10,000-pound drop-hammer would not be required, while in others the size of the drop-forgings produced may necessitate the use of hammers of this or even heavier weight of ram. A drop-hammer shop which would conveniently house fifty drop-hammers and the various accessory units, such as furnaces, upsetters, etc., would contain about 40,000 square feet of floor space. In an average fifty-hammer shop engaged in the production of forgings ranging in size from small levers to motor truck

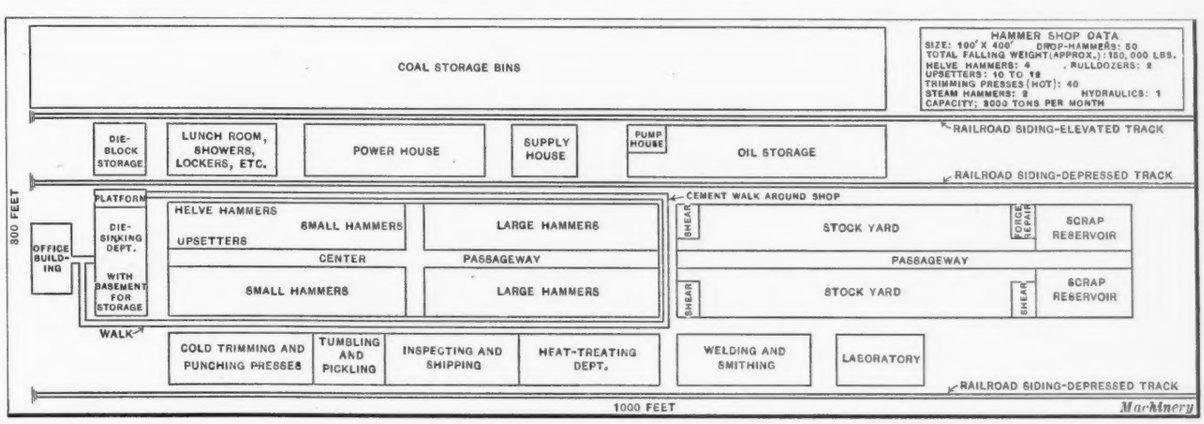


Fig. 1. Plan of Model Drop-forge Plant, showing Lay-out of the Different Departments

engine supports and axles weighing 300 pounds or more, there would be required, perhaps, thirty-five steam drop-hammers and about fifteen board drop-hammers.

The size of drop-hammers and the number of each estimated for a shop of this size is as follows: Four 1500-pound hammers; eight 2000-pound; ten 3000-pound; six 5000-pound; six 6000-pound; and one 10,000-pound hammer, giving a total falling weight of 128,000 pounds. Of the fifteen board drop-hammers the apportionment would be: Five 1000-pound, four 1500-pound, four 2000-pound, and two 3000-pound hammers with a total falling weight of 25,000 pounds. If very small forgings, eight or ten to the ounce, are to be manufactured, hammers as small as 300 pounds weight of ram will be required. Other drop-forge plant equipment would include four helve hammers; two bulldozers; from ten to twelve upsetters or forging machines, ranging in size from 2½ to 5 inches; about forty hot trimming presses; two open-frame steam hammers; and one hydraulic press.

Transportation Facilities

As shown in Fig. 1, the plant is served by three railroad sidings, one on each side of the hammer shop, having depressed tracks, and a third to accommodate the handling of coal, oil, and other stored supplies, which is elevated. A straight-away passage runs through the center of the shop, and extends through the stock-yard, which is a continuation of the forge shop. Both the forge shop and the stock-yard should be served by a full-width span traveling crane. For the accommodation of such a crane it is necessary to construct the building with rather high walls at the side, so that the crane may be run over the line of drop-hammers, when it becomes necessary to dismantle them in making repairs. This is an important detail, because the replacing of such parts as broken pistons on steam hammers is accomplished only with great difficulty, if a crane is not available.

The principal use of a crane is in the transporting of the finished product through the shop and the handling of the stock as it is taken from the cars and deposited in bins or other suitable storage space in the stock-yard. In the installation of a traveling crane, provision should be made for running the electric magnet over the concrete bins in the stock-yard where the scrap from the shears, the flash from the trimming presses, and the slag from the furnaces are deposited. The central passageway should always be kept clear, for by so doing the work can be more easily handled and the shop has a better appearance.

Hammer Arrangement

The usual arrangement of a drop-hammer shop provides for grouping a drop-hammer, a hot trimming press, and a furnace in such a manner that the hammer-man and his helper can work with the least difficulty. There are many ways in which these three units can be grouped, and in Fig. 2 are shown a number of different arrangements employed in several drop-forge plants. In the arrangement

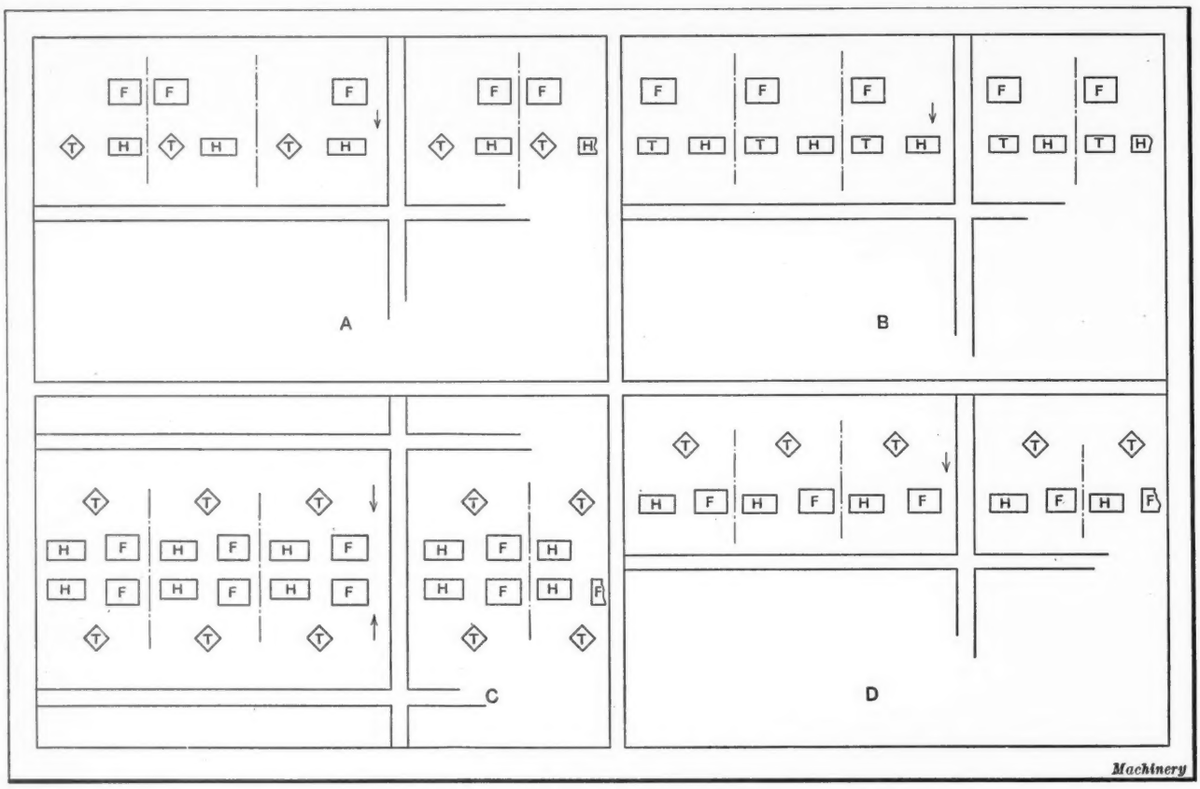


Fig. 2. Various Groupings of Drop-hammers, Furnaces, and Trimming Presses

shown at *A*, the furnaces extend in a row next to the wall so that the hammer-man must stand between the furnace and the hammer. In the winter, when the sliding doors are all closed, this arrangement may be as desirable as any. In the warm weather, however, when the doors are open, the heat waves from the furnace reduce the workman's efficiency. The idea of placing the trimming presses at an angle is a good one, and should be followed wherever it is possible.

In the diagram shown at *B*, the same general criticism applies, only that the furnaces are not directly in back of the hammers, but it is necessary on account of the trimming presses not being set at an angle, for the hammer-man to walk over between the hammer and the press, and thus there is the same objection to this arrangement. In both these instances the groups are strung along opposite walls of the hammer shop. In the arrangement shown in the diagram at *C*, the idea is to conserve space and facilitate the installation of fuel, air, and steam lines, by placing the furnaces and hammers back to back through the center of the shop with the trimming presses placed at an angle and not directly in line with either the hammers or the furnaces. This is a good arrangement, and in a monitor-roofed building affords excellent working conditions on

account of the facilities for ventilation and light. This arrangement also enables a narrow-span crane to be installed, which will not be required to make such a wide crosswise travel in handling the work as is required when the equipment is located along the walls of the building.

In all of these arrangements it should be understood that sufficient floor space is available to locate the upsetters, and other auxiliary equipment in some convenient locality. One disadvantage of the plan shown at *C* is that twice the amount of heat is concentrated through the center of the shop owing to the double rows of furnaces, so that forced ventilation might be required. Another point which should be considered, if this arrangement is contemplated, is the fact that another hammer is situated adjacent to the one on which each man is working, which may distract the attention of the men and have an unfavorable effect on the quality of workmanship.

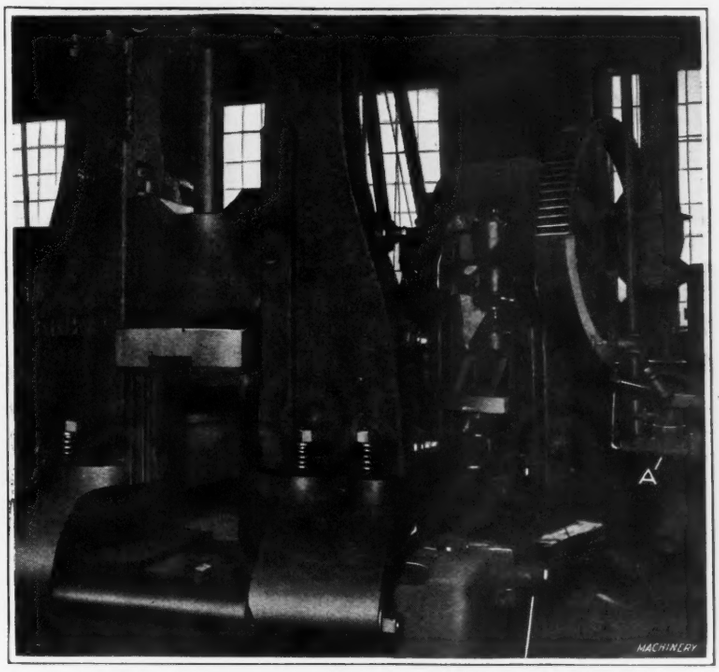


Fig. 3. Steam Drop-hammer, Trimming Press, and End of Furnace, showing Relative Positions

While the double-row arrangement shown at *C* has certain noteworthy features, it is probable that this arrangement, with the groups located along the side walls, is the best when all things are considered. Such an arrangement, which is shown at *D*, is used in a certain large drop-hammer shop in the Pittsburg district, and it is probable that this cannot be improved on. Fig. 3 shows a steam drop-hammer at the left, a trimming press in the background, and a furnace (only the burner side of which is visible) grouped in this manner. It will be understood that the hammer-man stands between the row of trimming presses and the row of hammers and furnaces, which are all in one line. Nothing is lost by this arrangement when the walls of the shop are closed in winter, and also certain considerably better working conditions are afforded in the summer. The incoming breezes blow the heat from the furnace away from the operator and toward the center of the shop, where if the roof is of monitor construction with suitable ventilation facilities, the heat will be carried away. The trimming presses are placed at an angle which is convenient for the forger.

A slight modification of this arrangement may be necessary on the smaller size hammers up to 2000 pounds capacity. This consists of using the same general arrangement, but including two drop-hammers to one furnace and trimming press. Work ordinarily handled on hammers of small capacity is of rather light construction and can be handled more quickly and in greater quantity than the heavier forgings; also, small work is often not trimmed hot, so in that case there would be but one hot-trimming press idle to two hammers, rather than one for each hammer, as would be the case if the suggested grouping were strictly adhered to, without suitable modifications where small work is involved.

The hammer shop consists of little more than a shelter for the drop-hammers and the workmen. The walls may be composed almost entirely of sliding doors made of corrugated sheet iron; this is an inexpensive construction and is just as good as a more elaborate arrangement.

Oil Storage and Piping

Modern oil-tank cars are provided with heating coils for preventing the oil from congealing during the cold weather, so that the cars may be run beside the oil storage plant and the oil siphoned or deposited by gravity into similarly heated boiler-plate tanks. This arrangement is convenient, but may be improved on by providing underground storage tanks, from which the oil is pumped direct to the furnaces in the hammer shop. Safety valves are required in the oil line at intervals to safeguard against fire and leakage losses.

Fig. 4. Railroad Siding and Manholes leading to the Fuel-oil Concrete Storage Tanks

In one modern drop-forge concern the oil storage plant consists of a number of sunken concrete tanks, and a pump house equipped with 3½- by 4-inch Goulds triplex pumps, which deliver the oil at 60 pounds pressure to the burners, through 2-inch iron pipe. The return pipe, through which the unused oil from the furnaces is brought back into the tanks, passes the oil through a pressure valve, so that both the supply and return may be provided with meters. The difference in the meter readings gives the oil consumption. Fig. 4 shows a view of the manholes and the piping by means of which the oil is carried into the tanks from the cars. The illustration also shows the railroad tracks and their proximity to the tanks as a convenience for supplying them with oil. The capacity of the entire storage plant is 350,000 gallons and each tank is provided with heating coils.

The construction of the tanks and their design may be of interest. There are fourteen of these, designed with a central passageway 5 feet wide, in which the feed and steam piping is arranged. The tanks, of which there are eight of the design shown in Fig. 5, are made of reinforced concrete, and are 18 feet long, 15 feet wide and 9½ feet deep. In constructing these tanks, the concrete is mixed in the proportion of one part cement, two parts sand, and four parts pea gravel. An equal number of tanks is arranged on each side of the passage, and the valves from the feeding pipes may be conveniently reached from the passageway. The tanks on each side are connected by outlets at the base so that they can be drained to the same level. Each tank and the passageway is provided with a manhole and a ladder for convenience when it is desired to inspect the tanks. The connecting ports may be closed if desired by a valve operated from the passage.

The walls of the tanks are waterproofed with a coating of pitch, great care being taken to seal all joints. Some of these tanks are fed from a common feeder (shown in the foreground, in Fig. 4), while in a later construction separate feeders are furnished each tank and each is drained separately from the others. On account of the slight weakening of the walls due to the action of the oil, the tanks are constructed heavily enough to allow a safety factor of from 10 to 15 per cent. It is probably unnecessary to use waterproofing material in the construction of concrete tanks intended for heavy fuel oil, because the oil after slight penetration, fills the pores of the concrete and makes them absolutely reliable. A wall 8 inches thick is sufficient to obviate the possibility of seepage. The tanks are located 18 inches below the yard level, which is covered with cinder so as to prevent excessive change in temperature of the oil.

The fuel oil pipes should be laid underground from the storage tanks to the hammer shop, and thence run along the wall, from which spur lines should be run down and laid underground to the furnaces. This arrangement permits any leaks in the pipe to be readily detected, and a number of valves can be provided at intervals for use in case of emergency. Repairs can be more readily made when the pipe is not run underground, and this practice is recommended in every case where possible. What has been said regarding oil pipes applies equally to gas pipes, air and steam lines, and electric wiring conduits. By providing a suitable enclosure around these pipes, the arrangement is probably preferable to that sometimes employed in enclosing them all in a concrete subway running the length of the shop.

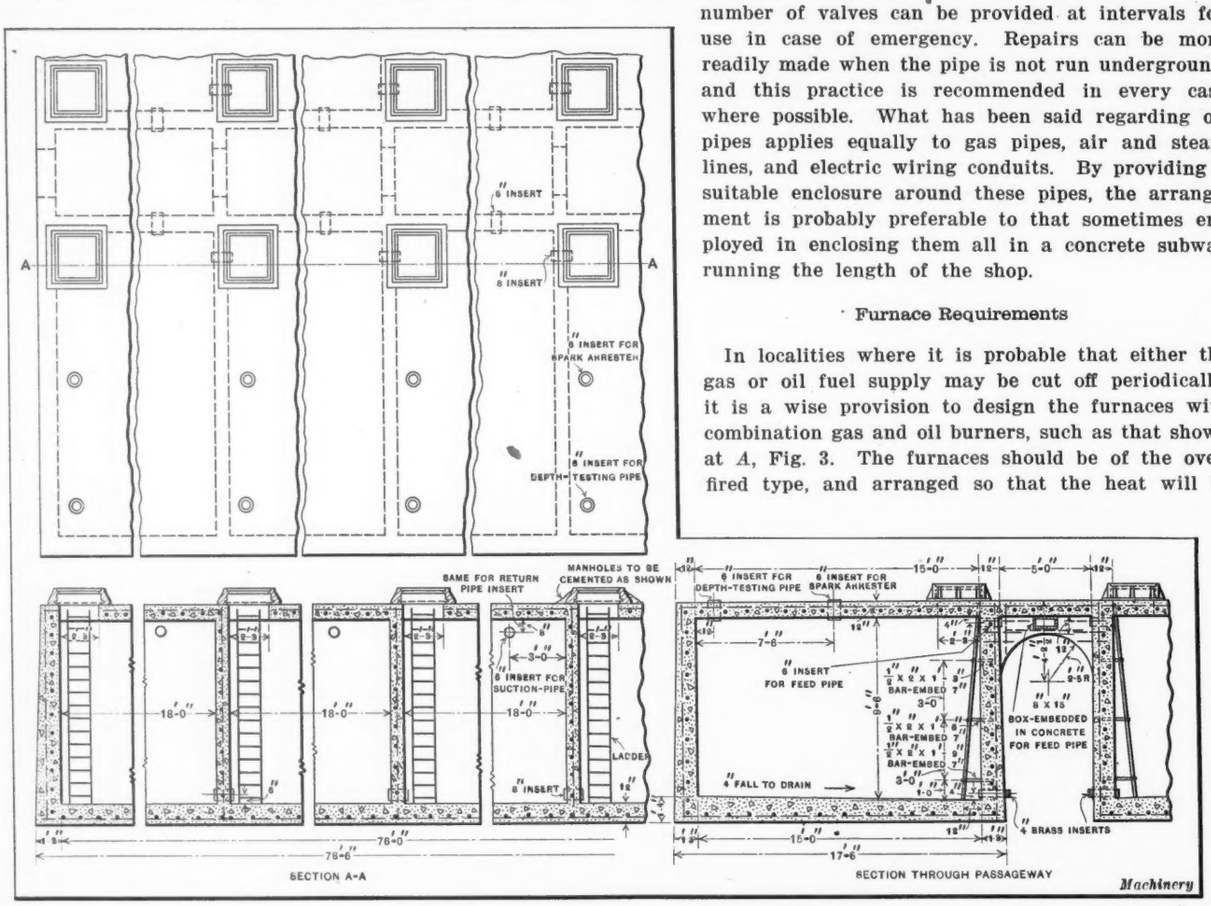


Fig. 5. Construction Details of the Concrete Oil-storage Tanks

Furnace Requirements

In localities where it is probable that either the gas or oil fuel supply may be cut off periodically, it is a wise provision to design the furnaces with combination gas and oil burners, such as that shown at *A*, Fig. 3. The furnaces should be of the overfired type, and arranged so that the heat will be conducted to the work by radiation rather than by direct contact. If a standard commercialized furnace is used, all details of construction will be taken care of in the design. The question of refractories for furnaces is of interest, particularly in connection with the making of repairs. Any good quality hand-made clay firebrick is suitable for the walls and roof of the oven, but for the hearth a chrome brick is more serviceable, because it is a resister to slag and consequently its use will prolong the life of the hearth. The furnaces used in connection with drop-hammers, forging machines, bulldozers, etc., are all of the same general type and have been described in detail in the technical press.

Blast for Furnaces and for Blowing Scale from Dies

The pressure of the air blast at the furnace burner should be governed by the style of burner selected for the furnace, and will probably be about six or eight ounces per square inch. Two blast lines of equal size should be provided, one

running the entire length of the shop on each side. The blowers for the air blast should be mounted on a platform at one end of the hammer shop, according to the general arrangement shown in Fig. 6, together with the motor for driving the blower. This illustration shows a 100-horsepower motor driving a Sturtevant low-pressure blower, and an arrangement such as this should be installed for each of the two blast lines. The blast line should be about 40 inches in diameter at the blower and should taper down to approximately 10 inches at the opposite end of the shop, to compensate for the loss of pressure as the air is delivered to the furnaces along the line.

The size of furnace burners will necessarily vary according to their location along the blast line; if a 4-inch mechanical sprayer burner, such as shown in Fig. 3, is employed, the outlet to the furnace should be 2¼ inches in diameter. Where the inlets to the burners are less than 4 inches, the outlet to the furnace should be decreased in the same proportion. As previously stated, these burners are of the combination type and are connected to the gas supply pipe so that the gas may be delivered to the combustion chamber of the furnace under the air pressure of the blast line.

Although in many shops air compressors are used for furnishing air to the hammers for blowing scale from the dies, steam has been used with equal success, thus eliminating the need for an auxiliary compressor. Steam may be taken from the line which feeds the steam hammers and which furnishes steam for the heating system of the plant. Referring to the general lay-out, Fig. 1, it will be seen that the power house is a separate building. The pipes for delivering the steam from the power house to the hammer shop should be covered with asbestos and buried in sawdust in a suitable concrete conduit, which should be located well below the frost line. In one plant where this arrangement has been in successful operation for a number of years, no difficulty has ever been experienced in the cold weather by excessive condensation of steam or by freezing.

Cold Trimming, Cleaning, Inspecting, and Shipping Departments

It is usually the small work that is trimmed cold, and in the suggested plant lay-out the cold trimming and punching presses have been located in a building adjacent to that end of the hammer shop in which the small drop-hammers are situated. The estimated number of presses required for handling the contemplated capacity is fifteen, but this like other similar data here given relative to equipment, may serve only as an indication of the amount of floor space that this department should occupy. In this department there should also be installed perhaps four disk grinders for snagging rough-trimmed forgings.

Next in order of location comes the tumbling and pickling room in which the acid tanks, tumbling barrels, sandblasting machines, and other ordinary cleaning equipment are installed. If the product is of small size rather than varied as would be the case in the average commercial shop, the quantity of tumbling barrels should be considerably greater in proportion to other cleaning appurtenances, to handle the work suitably. Usually the reverse will be the case, that is, a larger percentage of work will be cleaned by either sandblasting or pickling than by tumbling.

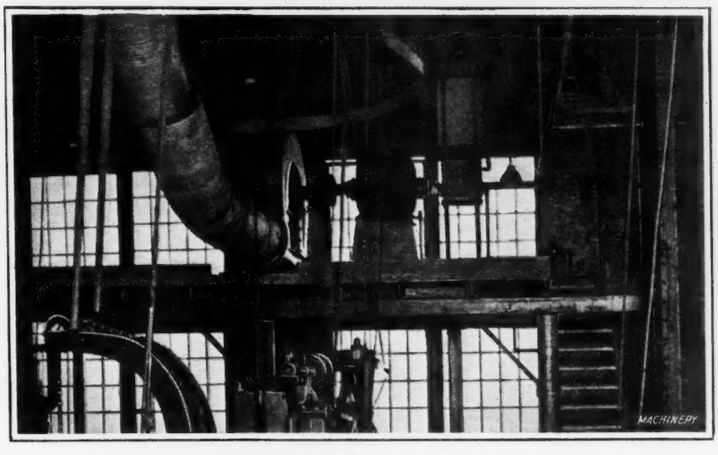


Fig. 6. Installation of Blower for the Air Blast Line

Fig. 7. Checking a Crankshaft at the Inspector's Bench

A convenient location for the inspecting bench is in the shipping room, which is located between the cleaning room and heat-treating department. A sample of all work in process should pass through this department and be checked by the blueprints before production is really started. Usually this process inspection occurs at least once a day for each job in the hammers. A liberal amount of floor space should be available for the tote boxes and trucks which will necessarily gather in the vicinity of the inspector's bench, and there should be ample space provided for the installation of suitable metal cabinets for filing blueprints. Fig. 7 is a view of an inspector's bench, showing a crankshaft resting on V-blocks while being checked; the blueprint cabinet is located at the further end of the bench. The suggested location of the shipping room is ideal for the most efficient routing of the work, either from the heat-treating department on one side, or if the product is not to be heat-treated, from the cleaning department. By depressing the railroad track, by means of which the outgoing material is shipped, the work of transporting the forgings to the cars is readily facilitated.

Repair Equipment for a Drop-forge Plant

It will be noted that in one corner of the stock-yard there is a space provided for repairing the furnaces. This department should be under the supervision of the man who looks after the furnace linings, and here should be stored the refractory materials and all necessary equipment for handling this line of work.

The welding and blacksmithing department is a necessary adjunct to the well-equipped drop-forge plant. The use of welding, in connection with drop-forging repair work, is quite necessary on the intricate designs of parts. The principal uses for welding in drop-forging plants are for building up parts of this type which have not entirely filled up the dies in the forging operation (due to wide variety in the shape and size of certain sections of one particular forging) and for repairing checks and cold shuts which, even under the most favorable manufacturing conditions, will sometimes be encountered. The equipment should consist of about

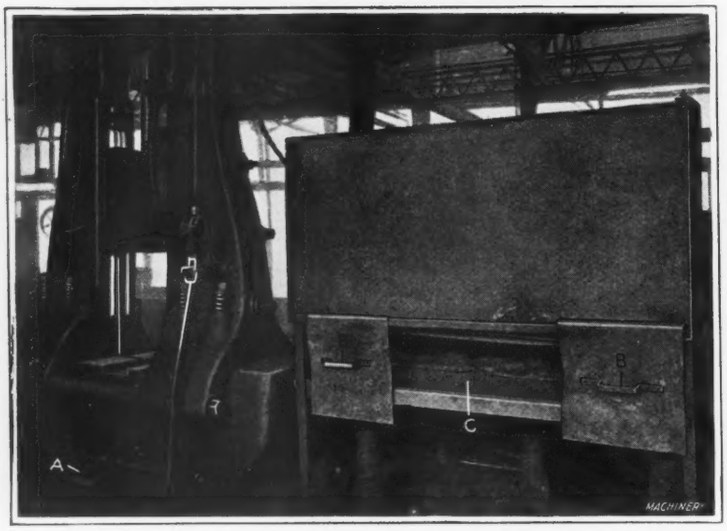


Fig. 8. Steam Drop-hammer and Furnace, showing Shortened Treadle, "Comfort" Blast, and Furnace Shields

six acetylene gas torches for use on this kind of work and a portable electric arc welding outfit for making repairs on tools and hammers. It has been found that the acetylene gas flame is more suitable for salvaging defective forgings than any other type of welding equipment.

It is sometimes advisable on long or tapered forgings where only a few are ordered and where the expense of making special dies would be prohibitive, to draw out the blank from which the forging is to be made. The blacksmith department should be suitably equipped for handling this kind of work. Adequate machines for the smithy department would include one helve hammer, perhaps three 1000-pound capacity and two 2000- or 3000-pound capacity open-frame steam hammers, a punch press, and eight or ten forge furnaces. A blower of suitable capacity should be provided for carrying away the fumes and gases from the forge furnaces, and the blower should be connected with a delivery pipe from a hood which should form a roof over the welders' benches. In this way all disagreeable gases will be removed.

Upkeep work of a general character, such as welding broken tongs, and repairing certain hammer parts, is assigned to this department. The nature of the work performed by the smithy and the welder is of such similar character that the logical arrangement is to place these departments together, and this has been done in the lay-out shown in Fig. 1.

Die-room and Storage House

One of the most important phases of the drop-forging industry is the manufacture and the hardening of the dies, and for this reason this subject will be considered in detail in a subsequent article. In the lay-out of a modern drop-forge plant a special storage house should be provided for the unmachined die-blocks as they are received from the steel mill. These blocks are often massive and awkward to handle, and the storage house should be located either in the same building with the die-sinking department or in close proximity to it. In the lay-out shown in Fig. 1 the storage house is situated directly opposite the building in which the dies are machined.

Facilities such as portable hoists should be provided for transporting the die-blocks from the storage space to the platform at the end of the die-sinking department. Storage space is also provided in the basement of the die shop, where the finished dies should be stored after they have been used and stripped from the hammers. This basement should be heated in cold weather, so that the dies will not become permeated with frost. Often such a condition has led to the fracture of dies when they are subjected to a severe blow in the hammer.

Improving Working Conditions

Accidents that occur around a drop-hammer are usually severe. One of the most common sources from which injury results is the accidental tripping of the hammer, due either to something heavy falling on the treadle, which extends the full width of the hammer, or by someone other than the operator accidentally stepping on the treadle. In one shop, measures have been taken to decrease the frequency of accidents resulting from this cause by shortening the treadle to about the width of an ordinary power press foot-treadle. Conditions under which the forger and his helper work, even with the best arrangement of equipment, are not especially favorable. The furnaces should all be provided with curtain shields to keep the excessive heat from the men's faces, and in almost every shop this is done. In Fig. 8 the treadle design *A*, previously mentioned, and a simple form of shield *B* for the furnace are shown, as well as a "comfort" blast for the furnace, which is indicated at *C*. This blast consists simply of a pipe from the air-line, perforated with holes so that the heat from the furnace is driven upward and away from the vicinity of the furnace-tender.

A suitable retiring room in which the showers and lockers are located is a necessary provision. Showers are a necessity, and the room should be especially well heated, because the men usually make use of this room when they are in an overheated condition. A complete change of clothing is necessary before the men can leave the shop, and this clothing must be thoroughly dried before it can again be worn. For this purpose, a clothing room in which the various pieces of wearing apparel are hung over steam pipes is an ideal arrangement. A view of the interior of one of these retiring rooms is shown in Fig. 9.

The equipment and lay-out of the heat-treating department and physical laboratory will be dealt with in a subsequent article in MACHINERY.

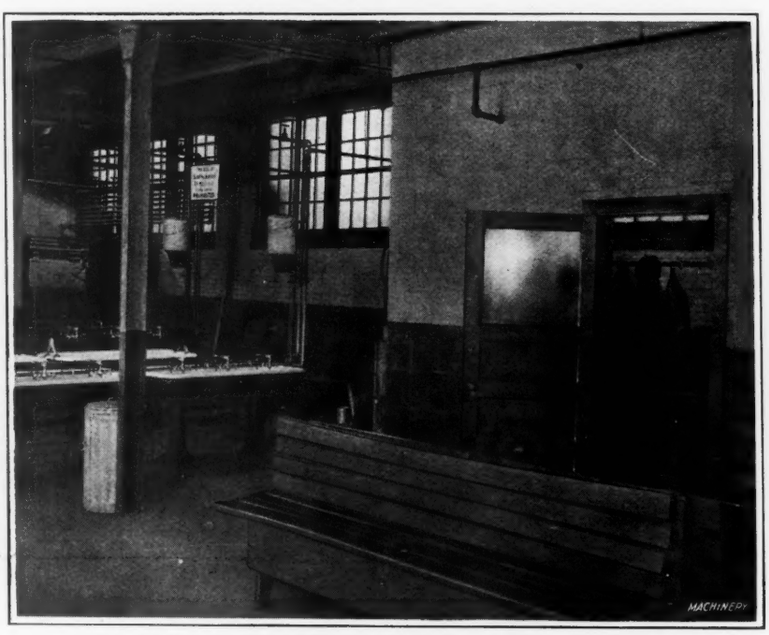


Fig. 9. Retiring Room, showing Showers, Wash Basins and Clothes-drying Room

Common Causes of Errors in Machine Design

The Dimensioning and Checking of Drawings—Seventh of a Series of Articles

By R. H. McMINN

IN the sixth installment of this article, published in the June number of MACHINERY, the matter of accuracy and clear representation in drawings was discussed. The present installment continues the discussion of points to be observed in making drawings in order to prevent errors in the finished part, taking up in detail the subjects of dimensioning and checking.

Dimensioning Drawings

In order for a drawing to be sufficiently dimensioned, it must require no extra figuring of dimensions by the shop departments in order to make all parts. As a general rule the shop should be required to make no assumptions regarding the shape or size of parts. There are a few exceptions to this, however. When the view of any part is rectangular, it is customary to give the dimension of only one end and one side, requiring the assumption that the opposite sides are parallel and the corners right angles. Likewise, when a view is circular it is not always necessary to add the word diameter, or an abbreviation, after the figure denoting the dimension, but the assumption is made that if it appears circular it is so unless other dimensions are given showing it to be elliptical.

If a detail has a number of identical parts, like the spokes of a wheel, it is not customary to give the dimensions of all, but only of one, and the rest are assumed to be the same unless otherwise indicated. If a flat bar has a line drawn down the center of its widest view, with holes located along this line, it is not always the practice to indicate by dimensions that the line is in the center of the piece, but it is assumed to be if not otherwise dimensioned. From the standpoint of accuracy it is better to definitely show that the line is in the center, as this is more likely to promote consideration as to whether the line should be in the center or off center to properly fit in with other details.

If the end view of a piece shows a number of concentric circles, like the end view of the trunnion in Fig. 10, it is best not to give the diameters of the various portions on that view, but on the side view or a longitudinal section. If one of these circles is distinguished in some way with bosses or holes having a circle as their center line, the diameter of this circle may be given on the end view. If a piece consists of a series of rounds and squares joined together along a common center line, they all appear rectangular in a side view or longitudinal section, as in Fig. 11. The dimensions of the round portions on the side view or section should therefore be followed by the abbreviation "diam.", and those of the square portions by "sq." The underlying principle is to so associate dimensions with parts that there will be no cause for misconception, and to describe the shape of the part dimensioned if necessary to more readily distinguish it from other shapes in the same detail.

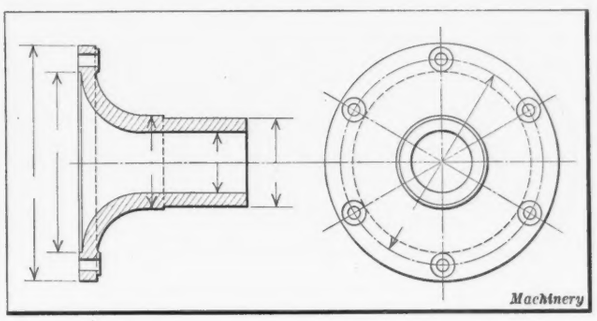


Fig. 10. Preferable Method of placing Dimension Lines on the Views shown

Dimensioning for Convenience of Shop

The fundamental principle to keep in mind in order to dimension any detail completely is that every detail consists of a combination of geometrical parts, each of which must be completely dimensioned in shape and size and be properly located by dimensions from other parts of the same detail. The ease with which the method of dimensioning can be used by the shop should always be considered. Following through in the mind the necessary operations which a patternmaker, machinist, or other workman must go through in laying out a part helps in this respect. Before denoting an angle on any part in degrees, consideration should be given to the shop's facilities for laying out or machining the part in degrees. In structural work, an angle is usually shown by giving the total length of two sides of a triangle or the slope of diagonals in inches per foot. Holes, surfaces, and parts should be dimensioned from other parts with which they have the closest relation in reference to accuracy of measurement demanded and, when allowable, ease of measurement. One should not give dimensions that are unnecessary and thus deceiving as to their importance, even though correct.

Time for Inserting Dimensions

There is no uniform practice as to what time during drawing, dimensions should be put on. Some draftsmen follow up their drawings closely with dimensions, while others wait until a detail is finished and then dimension. In following the latter method, only those dimensions that have been duplicated from another sheet, and those that may not be easily determined at a later time, or that cannot be scaled with sufficient accuracy, are put down immediately following the location of the lines or points they dimension. When the detail is finished, the rest of the dimensions are put in. This method has the advantage that after a detail is completed the exact space and location allowed for dimensions is evident. All dimension lines can first be added to the detail, and when this is done each dimension and pair of arrow heads can be inserted. This separates the work into two divisions, allowing first full attention to where it is best to locate dimensions and then full attention to what the dimensions should be.

Each dimension should be scaled prior to inserting the figures, as this gives a graphical check on it. If close attention is given to this scaling, it will prevent putting down dimensions that are very far wrong. Absolute accuracy of dimensions should always be aimed at, but, as a general rule, difficulties in the shop arising from a slight error in dimensions are more easily remedied than those caused by a large error. Dimensions should be kept separated as much as possible. Where they are crowded or the scale is small, use the letters C. L. for center line, C to C for center to center, and similar well-known abbreviations in conjunction

with a dimension, in order to make its meaning doubly clear. The location of a dimension should always be changed if, after it is inserted, it is left in an obscure place by later drawing or if a full line runs through it. An attempt should be made to avoid the use of small fractions like sixty-fourths, thirty-seconds, or even sixteenths in over-all sizes of large rough castings. These can hardly be maintained and are therefore deceiving as to their importance.

Center-line Extensions

A center line or any line extended for dimensioning purposes should not be allowed to accidentally coincide with any part to which it is not related if it gives a wrong impression regarding the location of the part. In Fig. 12 there are eight holes equally spaced around a circle which has a radius *R*. There are two other holes *C* and *D* shown in the diagram. These are so placed that when giving their distance from line *MN* at *J* a line through their center also passes through the center of hole *A*. If this is a mere coincidence encountered in drawing, it is probable that accurate figuring of the distance of *A* from *MN*, by using radius *R*, would show that *A* is not exactly in line with *C* and *D*. In such a case, a dimension should never be located at *J*, but at *K*, and the vertical center line between *A* and *C* should be stopped off, as between *B* and *D*. Even if the dimension from *A* to *MN* should by coincidence be exactly equal to *K*, the holes *A*, *B*, *C*, and *D* should preferably not be located on the same center line, unless they have a very close relation to each other, as in the attachment of some other part which has four holes in line.

Repeating Dimensions

It has often been stated that a dimension of a part given in one view should not be repeated in another view of the same part. The main reason for this is that if the dimension be changed in one view it may be overlooked in the other view. This principle of non-repetition is a good one for the engineering department to follow for its own benefit, but it may frequently be better to ignore it for the benefit of the shop or an erector. If it helps to identify holes, surfaces, or parts by repeating dimensions in different views, they should be repeated. It is especially convenient to have some dimensions repeated if different views of the same part appear on separate drawings. Preferably, dimension lines should not cross each other. It is better, however, to have them cross than to have them too far removed from the parts they dimension. An arrow-head is an important part of a dimension line. This is best seen when one is wrongly placed and is acted upon as shown.

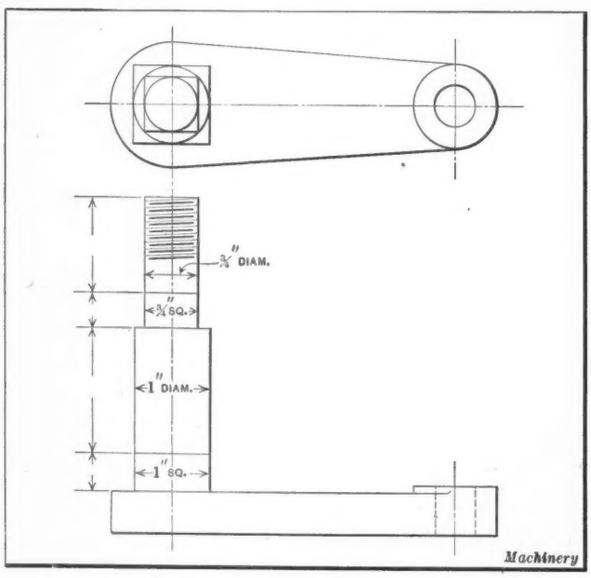


Fig. 11. Dimensioning a Part having Round and Square Sections

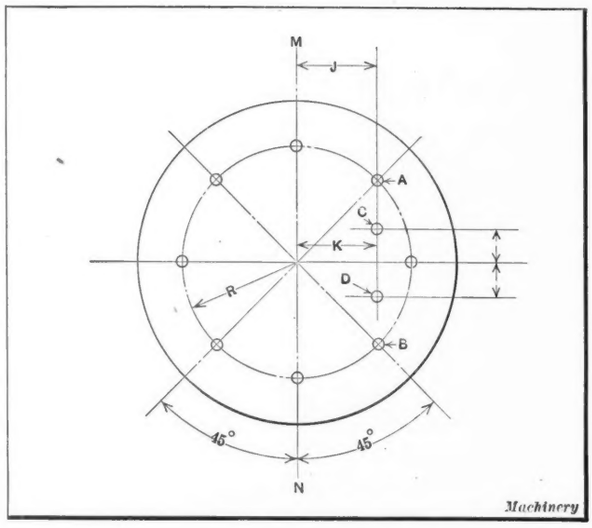


Fig. 12. Diagram illustrating Approved Practice in Regard to Use of Center Lines

Checking Drawings

The system followed in all well organized engineering departments whereby the drawings of designers and draftsmen are corrected by checkers unquestionably reduces the number of errors attributable to that department to a very small per cent of the number that would occur without checking. The first important requirement to insure that a set of drawings of a machine be properly checked lies in the checker acquiring a complete and accurate perception of the things to be accomplished by the machine. He should therefore first thoroughly examine all data and instructions submitted by authorities above the designer, so he may determine what result is required and what restrictions in form or size are placed upon the design by special conditions stated or clearances demanded. After this information is acquired, the drawings to be checked should be subjected initially to a comprehensive view and then to a minute inspection.

Preliminary Examination

The object of the first examination is to survey the machine as a whole and to determine, as far as can be done before completely checking, whether its elements appear to perform all of the main duties demanded. An endeavor should be made to exclude from the mind at this time the question of sizes, materials used, speed ratios, and considerations as to how the drawing is executed, unless some inconsistency is too glaring to be ignored. Such an observance by a checker may show that some important element has been omitted. For instance, it may be noted that a reciprocating member, like a cross-head on a punch press, requires some means of stopping it at the top of its stroke when a driving clutch is released. In this case the drawings may need such changes to provide the addition that it will pay to revise them before further checking.

Checking with Reference to Specifications

If it appears that the machine will function properly, the drawings should then be examined to see if they conform to all restrictions in design and size imposed by any specifications, drawings, or instructions of the purchaser or manufacturer. An error in over-all size or design imposed by the conditions surrounding the machine at its destination will not be discovered during the course of manufacture. Unless the inspection department is supposed to detect such errors —which should not be required of them—the error will not be discovered until the erection or trial of the machine. The correction of an error after the machine has been shipped is often difficult and costly, as well as damaging

to the prestige of the manufacturer. Such errors are probably the worst type, except those that cause loss of life, and therefore special care must be observed to avoid them.

While giving the drawings a comprehensive survey, the checker may be impressed that some special point needs checking. It may not be desirable to pause to check it when he is trying to concentrate on the broad features of design. It is well, however, to make a note of each such impression, for the strength of one impression is partially lost when others are received. The checker may observe that the machine has a swinging door, and wonder if, when it swings, it will clear a building column which is near; or a lever may appear somewhat inaccessible for the operator to reach. It may be more convenient to check these features later, but the importance of these points may be submerged by a clamor for him to get the checking done, and he may forget to consider them. It is therefore best to profit as much as possible by a fresh mind and more freedom from pressure which usually exists when one starts to check a set of drawings and to make a written note of anything which looks doubtful. In so far as possible, routine checking should be left until last, in order to preserve mental alertness for the checking which most demands it.

Checking the Details

When it comes to the more minute inspection, the function, form, size, quantity, material, finish, and part or pattern number of each detail must be checked. The drawing must show that nothing is omitted from the detail that should be attached; that each geometrical part is complete and correct in each view, and that the drawing is clear enough to be correctly understood. The necessary manufacturing operations must be followed through in the mind to see that the detail conforms with those requirements. It must be so dimensioned as to be made without further figuring or questions. Its clearance from other parts of the machine must be assured, as well as the ability to assemble, transport, erect, and easily remove it if necessary. The work must finally be resolved into checking the complete area of each drawing. Every point, line, figure, and word on the drawing needs sufficient evidence or reason for its approval. All notes on drawings should be read carefully to see that they are not capable of more than one interpretation. A set of drawings must be further checked to see if any element which is necessary for the proper functioning of the machine has been omitted.

The temptation to skip steps in the gathering of evidence needed in checking a detail must be resisted. More errors arise from failure to investigate questionable points than from arriving at wrong conclusions after investigation. It is not necessary, nor desirable, to investigate every doubtful point as soon as a question arises. An attempt should be made to preserve the continuity of thought as much as possible, so such points should be questioned in some manner on the drawing and looked up afterward.

Checking Dimensions

When checking dimensions, they should be added when possible, instead of subtracting, following somewhat the same method that is used in making change. Let us say that there are three intermediate dimensions on a detail, as 5½, 7 1/16, and 6 3/16 inches, their overall dimension given as 18¾ inches, and that 5½, 6 3/16, and 18¾ inches have been checked as correct. Instead of adding 5½ and 6 3/16 together, and subtracting from 18¾ to see if 7 1/16 is correct, the three smaller dimensions should be added to see if their sum is 18¾ inches. All dimensions arrived at by subtracting should be checked by adding. It promotes accuracy, except in very simple cases, to first tabulate in a vertical column any series of dimensions to be added. This allows the feet, inches, and fractions to come in rows under each other. The transferred figures should be checked to see that each figure has been correctly transferred and that only those required have been included. This separates the work of deciding what dimensions must be included in a series, in order to obtain a desired dimension, from the actual work of adding.

Checking Bills of Material

Errors often occur in lists or bills of material which give the quantity, kind of material, names, part numbers, and sizes of the parts required for making a complete machine. As these lists may form the basis for determining a large portion of the material that is especially purchased or made up for a machine, they must be thoroughly checked. It is a good plan to go over the bills of material, after they have once been checked, and select single items that are costly, either because they consist of one expensive part or a large quantity of less expensive parts, and again check the description of these items in order to reduce the chance of costly errors to a minimum. If the bills should be written to include material for a large number of duplicate machines, each item should have this second checking, preferably by another person.

It is important to clearly indicate, as one proceeds, what has been checked on a drawing. In this way repetition of work is avoided. When a discrepancy is discovered, a prominent enough notation should be made so that there is no chance for it to be overlooked.

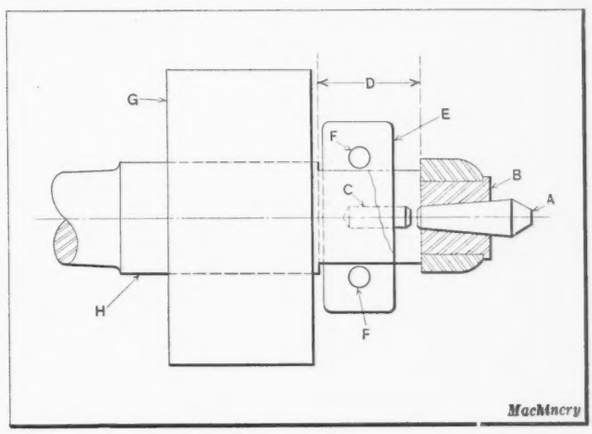
* * *

CHUCK FOR HOLDING SMALL TAPER PINS

By P. BERTLES

The device shown might be termed a "non-stop" chuck, as it is so designed that small taper pins can readily be inserted or removed without stopping the machine spindle. It can be used in performing light turning operations on the ends of taper pins, and is especially well adapted for holding pins of the type shown at *A*, which require the end to be ground smooth and at right angles with the axis of the tapered body.

Part *H* is an extended live spindle provided with a loose fitting collar *G*. When slid or forced quickly forward by the hand, this collar will hit part *E* with sufficient force to cause the hardened pin *C* to knock out part *A*. Spindle *H* is flattened for a distance indicated by dimension *D*, so that pins *F* will glide on these flattened surfaces. Part *E* is made a sliding fit in a slot through the spindle. A hardened bushing *B* provided with a tapered hole to fit the work is placed in the end of the spindle to prevent undue wear. In using this chuck, the spindle is set in motion, and the work *A* inserted in bushing *B*, after which it is given a light tap with a hammer. After performing the machining operation, collar *C* is quickly brought forward, thus causing the work to be ejected from the bushing so that a new piece can be inserted.



Chuck for holding Small Taper Pins

Some Products of a Modern Tool-room

Description of a Jig for Drilling One Hundred Holes, and a Small Assembling Fixture Produced in the Toolmaking Department of the Leeds & Northrup Company of Philadelphia, Pa.

By CHARLES O. HERB

A WELL equipped and wide awake toolmaking department is essential to the development of time- and labor-saving methods of manufacture in a modern machine building establishment. Such a department usually produces, not only tools for performing the cutting operations on a piece of work, but also ingeniously constructed jigs, fixtures, and other devices whereby the existing method of performing an operation is replaced by a method permitting a higher rate of production and, perhaps, a higher quality product. In order to have the department truly efficient, it should contain several skilled toolmakers or designers having the ability to judge whether the manufacturing methods in use can be improved upon and in what way. Although the initial cost of a device built in the toolroom is generally comparatively high, owing to the necessity of employing highly skilled mechanics, the time usually saved in the performance of an operation by the use of the device is such as to more than warrant the expense.

The Leeds & Northrup Co., Philadelphia, Pa., has a large modern tool-room equipped with machines of the precision class and several electric heat-treating furnaces provided with recording pyrometers of the potentiometer type which are manufactured by this concern. Hardening is performed by using the "hump" method for indicating when the part being heated reaches the decalescence or critical point. Recorders control the temperature of the tempering furnace by automatically operating switches when the temperature becomes greater or less than that desired. In the following will be described two tools built in this department by means of which the operations on two respective parts are performed in a more economical and satisfactory manner than previously.

Jig for Drilling One Hundred Holes in Recorder Frame

The main frame of a potentiometer recording pyrometer is shown in Fig. 2, from which the distribution of the numerous holes may be observed. This frame is a bronze casting weighing about 7½ pounds. All the holes drilled in the part are not shown in the illustration, but there are approximately one hundred, ranging from those produced by a drill of gage No. 52 to one that is ½ inch in diameter. Originally all these holes were laid out prior to the drilling operation, a step which obviously required a vast amount of unnecessary labor, the time consumed being approximately four days of eight hours each. In an endeavor to perform this operation on a production basis, the jig illustrated in Figs. 1 and 3 to 6, inclusive, was developed, and consequently all the holes are now being drilled in about thirty minutes.

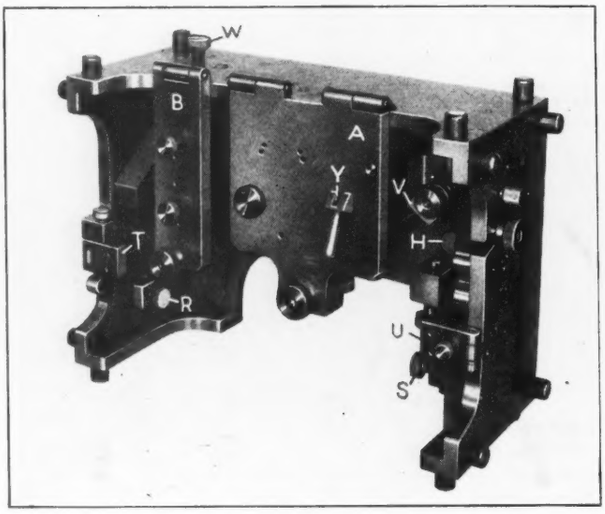


Fig. 1. Jig designed for drilling One Hundred Holes in the Main Casting of a Recording Pyrometer

The operation is performed on a drilling machine having four spindles, but only one hole is drilled at a time. There are ten different sizes of holes in the frame, and the procedure followed in producing them is to drill all those on one side of the jig which can be produced by the four drills mounted in the spindle sockets, and then drill those on the other sides. The drills are then replaced by others and the same method followed as before, in this way reducing to a minimum the changing of drills. By observing leaf *A* of the jig in the various illustrations, it will be seen that some of the holes to be drilled are spaced so close together that it is necessary to provide two guiding holes in one bushing.

There are approximately two hundred parts entering the construction of the jig, including the various bushings, and all these parts are hardened in the electric furnaces previously referred to. A point of unusual interest in connection with the hardening of these parts is that each one is ground accurately prior to the operation and their size and shape are not affected by the hardening process, so that it is unnecessary to regrind them afterward. In fact, the only surfaces requiring lapping are the holes of bushings larger than ¼ inch in diameter and, in these instances, only about one-quarter of a thousandth inch of metal is removed. The success of the hardening processes is attributed to the use of the "hump" method previously referred to. The bushings and the various surfaces of the jig which make contact with the work are hardened to a scleroscope reading of 95 to 100.

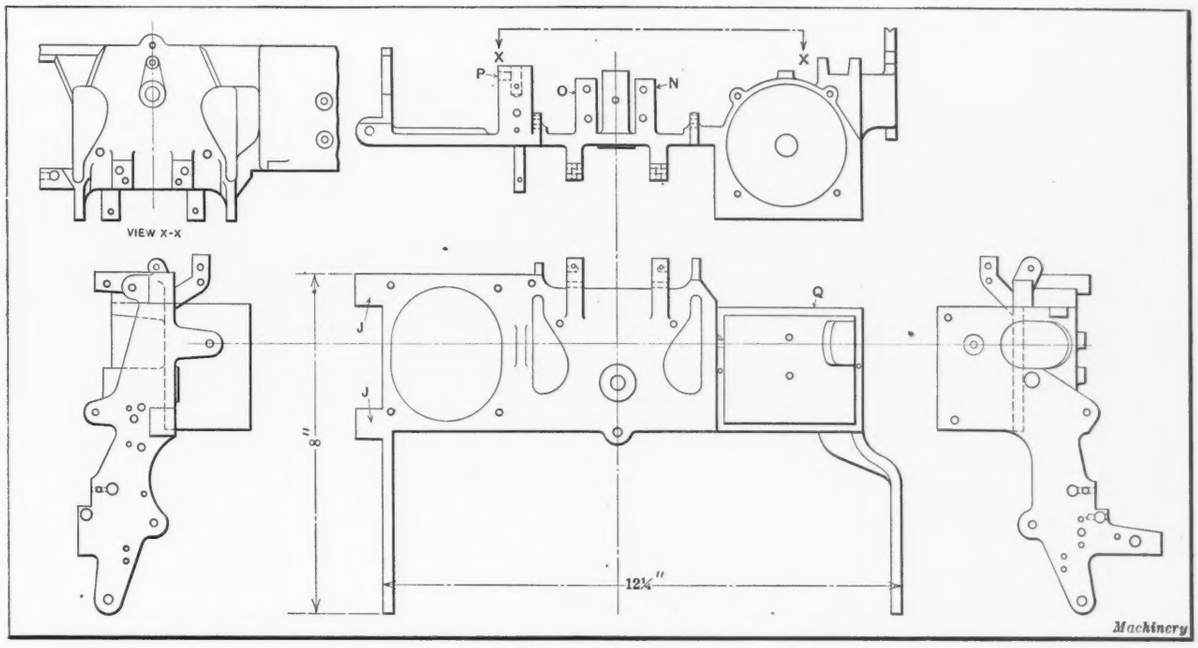


Fig. 2. Frame of Potentiometer Type of Recording Pyrometer for which the Drill Jig shown in Figs. 1 and 3 to 6, Inclusive, was designed

General Description of Drill Jig

The reference letters used in the following description of the jig refer to the same part in the different illustrations. In Fig. 1, the jig is shown with the various leaves and clamping members, except clamp *V*, in the positions occupied when the work is in place and the jig has been made ready for the drilling operation; however, the work is not shown in place in the jig. Fig. 3 shows the jig with the movable members arranged for the insertion of work, while Fig. 4 shows the jig after the work has been inserted but before the leaves have been lowered. Assembly views of the jig are shown in Figs. 5 and 6, but as they are the original designs which were not strictly adhered to in the making of the jig, they do not entirely agree with the jig as shown in the other illustrations. Nevertheless, the general design is sufficiently similar to be of value in connection with the description.

When placed in the jig, the work rests upon surfaces *C*, *D*, *E*, *F*, *G*, and *H*. Link *I* is then lowered and clamped in place by means of the knurled nut on a screw projecting from the side of link *I*, which operates in the slot on the right-hand end of the jig. Movement of link *I* is also prevented by means of a locking pin having a push fit. The purpose of the link is to hold down ends *J*, Fig. 2, of the casting. Clamping screws *K*, *L*, and *M* on the front of the jig are then tightened, forcing the work against the bearing surfaces at the rear provided for lugs *N*, *O*, and *P*, and surface *Q* of the work, and thus properly locating the work in that direction. Clamping screws *R* and *S* are then tightened against the legs of the work, and clamp *V* swiveled and tightened against a raised surface. Leaves *T* and *U* are next lowered and locked in place by means of pins having push fits, the pin for leaf *T* being located in a horizontal position, and that for leaf *U* in a vertical position. Leaves *A* and *B* are finally lowered and secured by means of the eye-bolt clamps at the front of the jig, and the two clamping screws on leaf *B* and that on leaf *A* are tightened against the work. A clamping screw *W*, Fig. 1, is also furnished at the back of the fixture.

The cam-operated clamp *Y* on leaf *A* is operated after all the clamping screws have been tightened. The clamping screws in each case are only tightened to bear slightly against the work, and the function of the cam-operated clamp is to hold the casting securely in place. This clamp is provided with a coil spring that regulates the pressure applied to the work, so that the pressure will not be sufficient to cause distortion of the casting, and, at the same time, the spring insures that there is enough pressure on the casting when the thickness of the latter happens to be a trifle under size. The time required for the building of this jig was 650 hours.

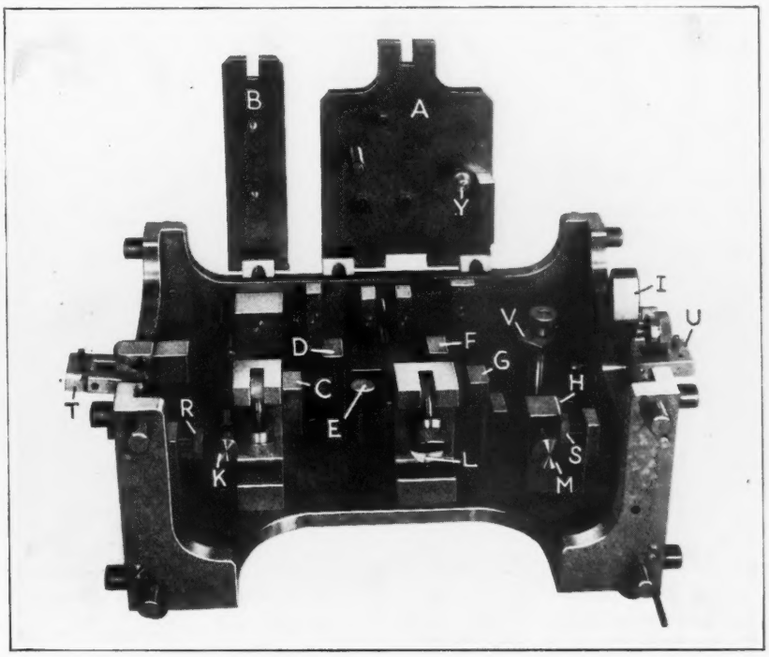


Fig. 3. Jig with Movable Members in Position to permit the Insertion of Work

Fixture for Assembling Tungsten Tip on Brass Screw

The device illustrated in Fig. 7 was designed to facilitate the assembling of the part shown at the right in the same illustration, which is a governor contact screw also employed in the construction of some of the temperature-recording instruments manufactured by the

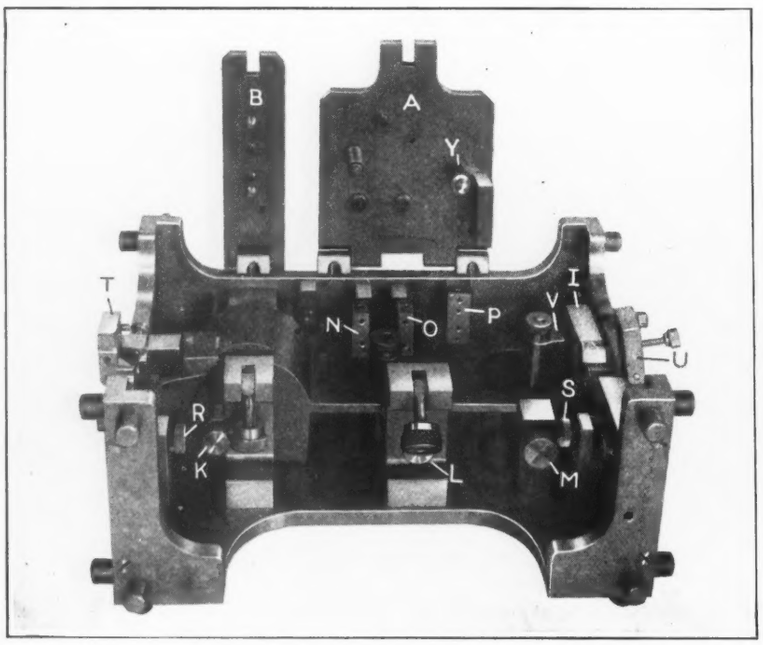


Fig. 4. Manner in which the Work is placed in the Jig

Leeds & Northrup Co. The assembling operation consists of gripping the shank of a machine steel part so tight in a hole in the lower end of the screw that the two parts will be held securely together. A small disk of tungsten is welded to the face of the machine steel part. The screw is made of brass, is a No. 8 size, and has 32 threads per inch. The head is made of hard rubber and the threads at the opposite end are turned off for a distance of about 1/16 inch from the end for the purpose of furnishing a smooth surface for the assembling operation. The shank of the machine steel part is 0.045 inch in diameter, and the diameter of the tungsten tip is 7/64 inch.

In the operation of this device, the tungsten tip is placed in the counterbored hole in the upper end of screw *A*, with the machine steel shank projecting upward. A screw with the rubber head attached is then held in an upright position in the opening of the device, with the lower end placed over the shank. Lever *B*, which is provided with three cam grooves that engage a pin contained in each of jaws *C*, is then operated in a clockwise direction, the result being that, owing to the action of the cam grooves, the three jaws are brought into contact with the screw, with such force that the shank is clamped securely in it. The device is bolted to a bench, and the assembly of screws is performed by a girl, the rate of production averaging 125 screws per hour.

It is evident that the position of the upper end of screw *A* can be adjusted so that the jaws *C* will always grip the smooth cylindrical surface on the screws. The function of plate *D* is to tie the movable parts of the device to the base. The base is made of cast iron, while the remaining parts are made of steel, jaws *C*, the circular portion of lever *B*, and screw *A*, being hardened. The outer end of lever *B* is provided with a wooden grip. After the device had been used for some time, a stop-pin was located in the base to stop the movement of lever *B* at a certain point so that jaws *C* would not be forced against the screws sufficiently to punch holes entirely through the brass wall surrounding the machine steel shanks.

Prior to the development of the assembling method described, the tungsten tips were brazed to the screw, but this method was decidedly unsatisfactory because in the operation the brass screws became burned, and the threads at the brazed ends covered with a hard coating of borax. The latter material was used in the brazing operation to protect the metal from oxidation and to dissolve the oxides formed. In order to remove the borax coating, it was necessary to dip the screws in acid, and run a die over the end threads. When this assembling method was employed, the production was only fifteen per hour and the number of screws rejected amounted to approximately 15 per cent, whereas by using the device described in the foregoing, the screws are assembled uniformly and the rejection is less than 1 per cent.

* * *

CUTTING A STEEL RISER WITH AN OXY-ACETYLENE FLAME

An unusually severe task recently performed by the use of the oxy-acetylene flame was the removal of a 44-inch square riser from a steel casting in the Attica, Ind., shops of the National Car Coupler Co. The operation was rendered especially difficult on account of the riser being in an upright position, which necessitated the taking of a horizontal cut. The procedure followed by the operator was to first cut the corners of the riser at a point close to where it was attached to the casting, so as to reduce the cross-section at this point. This operation was repeated until the cross-section was reduced to such a small area that it could be easily cut through.

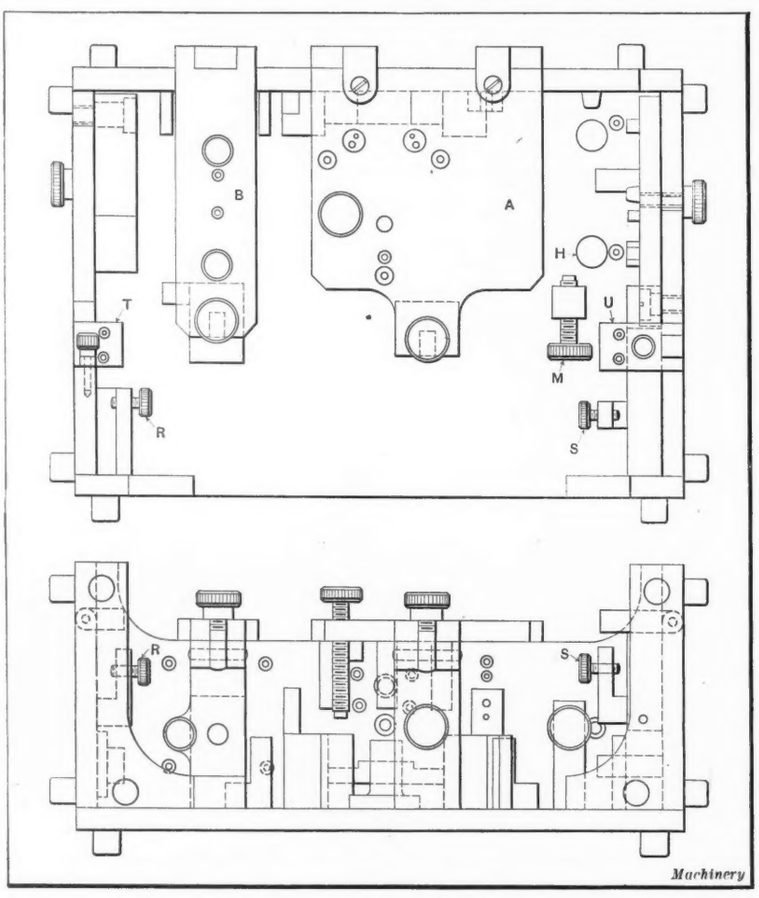


Fig. 5. Original Design of Jig for drilling Pyrometer Frame

THE KJELLBERG PROCESS OF ELECTRIC ARC WELDING

In electric arc welding processes, before the introduction of the wire electrode method, it was usual to fuse together the metal of the object being welded and the metal added by means of an electric arc formed between a carbon electrode and the object. For this purpose, a carbon rod or electrode, held in a suitable holder, is applied to the object in such a way that an arc is struck and the metal to be added, which may be in the form of a rod or otherwise, is fused by the arc simultaneously with the object, thereby producing a more or less perfect weld. In this method no provision is made for preventing the contamination of the weld by carbon from the electrode, nor oxidation by the oxygen of the air, so that the weld obtained is so hard that it cannot be machined.

In the Kjellberg process the disadvantage referred to has been overcome. With this process a steel rod is used as an electrode, instead of the usual carbon rod. In itself, the use of a steel rod as an electrode is not new, and the result obtained with such a rod, by the ordinary method, is not much better than that obtained with carbon electrodes. In the Kjellberg process, however, the steel rod is covered with a coating or sleeve of normally non-conducting materials, that is to say, conductors of the second class, the function of the cover being to direct the metal where it is required, to protect the fused metal from oxidation, and to make up the loss in the arc of certain constituents of the iron or steel forming the object.

In carrying out the process, the covered rod is held in a clip or holder connected to a continuous current supply, and forms the positive pole, the object forming the negative, though in some cases the polarity is reversed; also every phase and frequency of alternating current can be used. The covering is removed from the end of the rod to enable the current to pass, and an arc is struck between the rod and the object. As soon as the arc is struck, a portion of the metal of the object, having an area approximately equal to the section of the rod, fuses, together with metal from the end of the rods, and at the same time the covering, which is of a friable nature, partly fuses and breaks away at the same rate as the metal of the rod is deposited. In this way metal can be gradually deposited on an object until a sufficient quantity has been obtained for the purpose required. From time to time the deposited metal can be mechanically forged, so as to consolidate it in exactly the same way as a weld made in the fire.

A further advantage of the covering on the rod is that the tensile strength of the weld can be varied within certain limits to suit the purpose required. For example, by this process the weld may have a tensile strength of from 20 to 35 tons per square inch. It is possible also to obtain various degrees of hardness merely by altering the composition of the covering. The use of welding rods, covered in accordance with Kjellberg's patent, has rendered it possible to do a large amount of work that could not be successfully undertaken before. As the metal is deposited in small quantities and the heat is localized within a very small area, the danger of setting up internal stresses is reduced to a minimum. There is no limit to the size of the work that can be welded, which constitutes a very important difference as compared with oxy-acetylene gas welding.

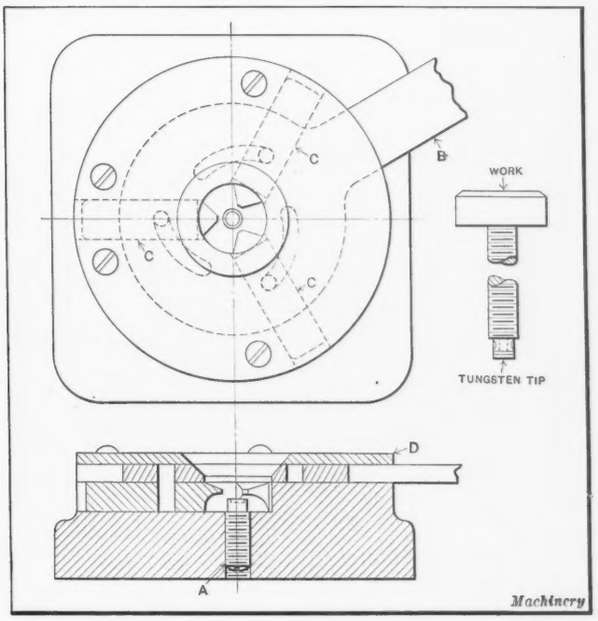


Fig. 7. Device employed to clamp Tungsten Tips to Brass Screws

The Kjellberg system of electric arc welding is the latest system to receive the approval of Lloyd's Register for use in the construction of ships' hulls. This system is practised in England by the Anglo-Swedish Electric Welding Co., Ltd., London. Some particulars of the early work carried out by this system have been published in the *Engineer*. In these articles Mr. Kjellberg's views on the application of electric arc welding to shipbuilding were given.

So far this system has been chiefly used for repair work in connection with boilers, but it is equally applicable to new construction, and having now obtained the approval of Lloyd's Register, no doubt constructional work will be undertaken where and when opportunity arises. The Anglo-Swedish Electric Welding Co. has recently completed what is said to be the first marine boiler constructed in England in which most of the joints have been welded instead of riveted. This boiler is of the usual marine type, having three furnaces, and it was especially designed for welded joints. It is 15 feet 6 inches in diameter and carries a working pressure of 180 pounds per square inch. The joints between the shell and the end plates are welded, as are also the joints of the combustion chambers, there being a total length of welding of about 500 feet. The boiler was found to be absolutely tight in a hydraulic test at 360 pounds per square inch, without any touching up being required. The steam trials were equally satisfactory, and the boiler has now been under steam for some time.

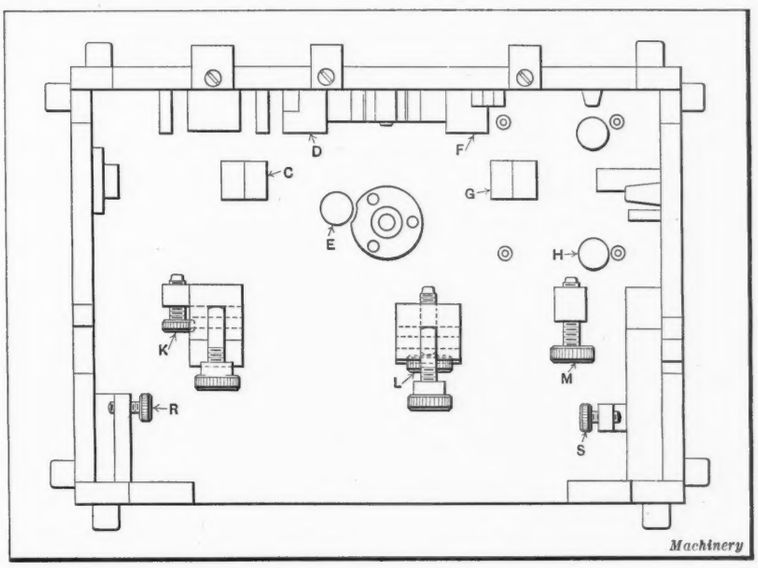


Fig. 6. Plan View of Original Design shown in Fig. 5 but with All Leaves removed

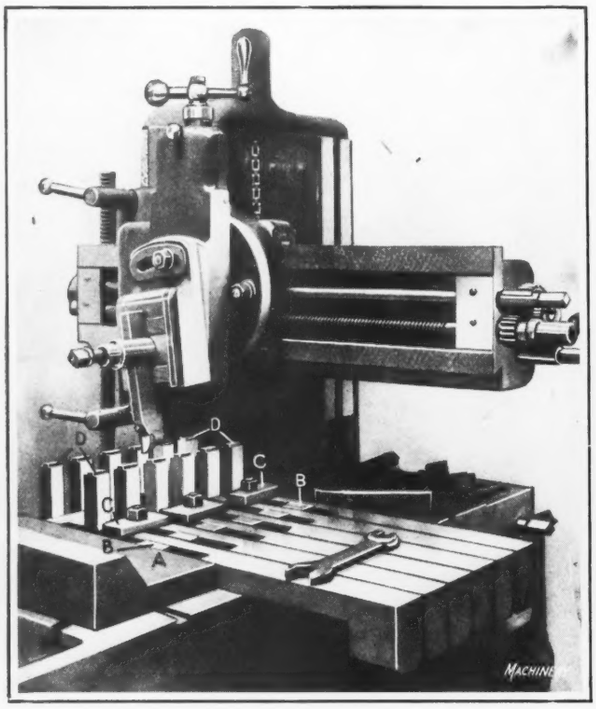


Fig. 1. Rough planing Operation on Vertical Faces of Front-slide Carriage Links for Lathes

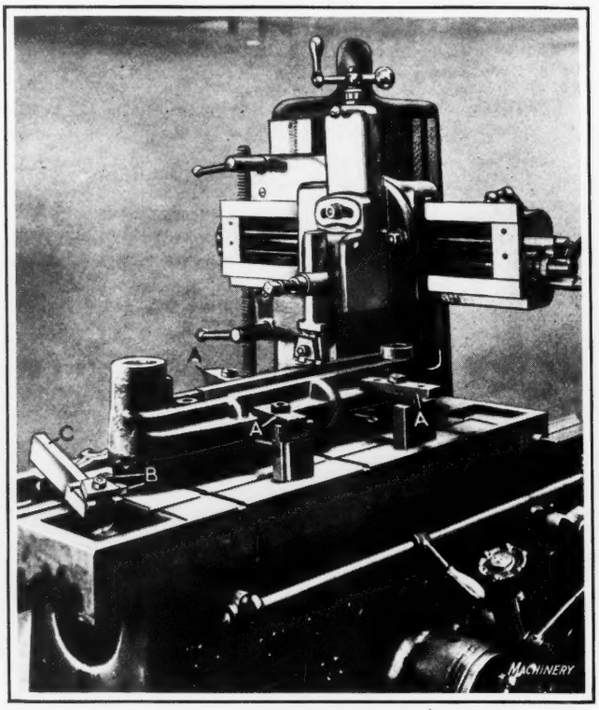


Fig. 2. Finish-planing the Slot of a Crank-arm for a Coulter Open-side Shaping Planer

Results Obtained with Crank-driven Planers

Methods of Operating Machines Possessing Features of Both the Planer and Shaper

By EDWARD K. HAMMOND

FOR use in machining small and medium size pieces, the Cincinnati Shaper Co., Cincinnati, Ohio, builds what is known as a "crank planer"; and a machine known as the Coulter open-side shaping planer, which is equipped with the crank driving mechanism used on shapers, is built by the Automatic Machine Co., Bridgeport, Conn. There also are several other machine tool builders engaged in the manufacture of similar machines which are adapted for about the range of work that is handled on the equipments which have been specifically mentioned. In this article, an outline will be given of the methods used in a number of well-known manufacturing plants in tooling up machines of this type and in operating them on repetition work.

It is claimed for the shaper of standard design that it is adapted for handling many of the same classes of work that might be done on a planer. Advocates of the shaper also call attention to the fact that for those jobs which come within its range, reductions of production costs are effected through the possibility of doing the work on a machine that represents a lower initial investment and against which a proportionately smaller overhead must be charged; also, that such a machine occupies less floor space in the shop, and that it can often be satisfactorily operated by a less experienced and lower priced workman than is required to take charge of a planer.

For the so-called crank planers, it is claimed that they possess the strength, rigidity, power, ample capacity, and ability to perform accurate work which are well-known characteristics of the planer, and added to these features there are speed of operation, positive control of the length of stroke, and various other labor-saving characteristics of the shaper. An important advantage of this type of machine arises from the possibility of positioning the platen under the tool, without in any way altering the length of stroke. This makes it possible to cover a surface more than twice the length of stroke, and is frequently taken advantage of in planing two surfaces located some distance from each other on a piece of work, without requiring a second setting. Where such a procedure is followed, the work is first planed at one end, and then the other end is brought under the tool, ready for completing the operation. Still another distinctive feature of a crank planer is that the method of driving affords an accelerated cutting speed, the rate of travel of the work under the tool attaining a maximum near the center of the work and being reduced to zero at the point of reversal. This accounts for higher cutting speeds being employed than on an ordinary planer, because the work is permitted to gradually attain its maximum speed in passing under the cutting tool and then to have its rate of travel decelerated prior to reaching the point of reversal.

For work that comes within its capacity, the crank-driven planer gives satisfactory results, both as regards the quality of workmanship and the rate of production. The crank drive affords positive control of the stroke, and it is a simple matter to adjust the length of stroke as required. In the present article, descriptions are given of the methods of equipping and operating machines of this type for the performance of typical operations on production work.

In the performance of planing operations, these crank planers are in the same class as the short-bed lathes which have fully demonstrated their practicability as manufacturing machines for the handling of small and medium sized pieces, which would otherwise have to be set up on lathes having far

more capacity than is required by the work. With this introductory statement concerning the advantages which may result from the use of medium sized planers of this kind, a description will be given of a number of specific operations handled on such machines, in order that the reader may visualize the methods that are used and the rates of output that are attained.

Planing Links for Front-slide Automatic Lathe Carriages

Front-slide carriage links for use on automatic threading lathes built by the Automatic Machine Co., have a forked end which has to be planed on the inside and bottom; and it is also required to machine the top of each arm of the fork to the form shown in Fig. 1. The links are finished all over on this machine, and previous to the set-up shown in the illustration, they have been planed on their sides and base, and these surfaces are utilized as locating points. Referring to the illustration, it will be noticed that an end-stop *A* is secured to the Coulter open-side shaping planer table, and owing to the form of the work, it is necessary to use parallel spacing blocks *B* between adjacent pieces, in order to provide for squaring them up with the line of travel of the planer table.

With a preliminary location obtained in this way, the pieces of work are held back against stop *A* by means of bolts (not shown) which apply pressure behind the last piece of work. Then, the work is held down by means of straps *C*. It will be noticed that as they are set up on this machine, the ends of these pieces of work overhang for a considerable distance beyond the table, and for this reason the open-side feature of the Coulter planer is the means of enabling a job of this kind to be easily handled, when it would otherwise exceed the planer's capacity.

The inner sides of forks *D* on the work are rough- and finish-planed with side tools, one of which is shown in operation; and it will be seen that the tool-box has been set over at an angle, in order to afford clearance for the tool as it is fed down the vertical face of the work. The three top faces of each arm of the fork, and the bottom of the space between the two arms are rough-planed with a diamond-point tool, after which the top faces of each arm, including the tongue and the space between the arm, are finish-planed with a square-nosed tool 7/16 inch in width. As shown in the illustration, there are six pieces of work set up on the machine for planing, and two hours are required to set up and perform the necessary sequence of operations on this number of links. The dimensions of the work are held within limits of + 0.001 inch and — 0.

Planing the Slot in Coulter Shaping Planer Crank-arms

Mention has previously been made of the fact that the reciprocating movement of the Coulter open-side shaping planer table is accomplished by a shaper crank mechanism. Fig. 2 illustrates one of the crank-arms for this purpose, which is set up on the table of an open-side planer used in the Automatic Machine Co.'s plant for machining the top surface of this piece, and the side walls and bottom of the crank slot. From the illustration it will be apparent that there is a bearing boss at each end of the crank-arm, both sides of which have been previously faced on a milling machine, and these finished faces of the bosses are utilized as locating points for setting up the work. It will be apparent that the method of clamping is quite simple, consisting of two straps *A* on each side and an end-stop *B* to support the tool thrust. It is necessary to have the slot centrally located with the sides of the casting, and square with the faces of the bosses. The bearing holes at each end of the arm are bored after the slot has been finished, the slot being used for locating the work on a horizontal boring mill, so as to get the holes central with it.

With the work set up as described, the first step is to rough-plane the top surface of the crank-arm, a diamond-point tool being used for this purpose, after which a square-nosed finishing tool 7/16 inch in width is employed for taking a second cut over the same surface. Next, the sides and bottom of the crank slot are roughed with a double-pointed tool of the form that is best shown lying on the bed of the planer at *C*. In this connection, attention is called to the fact that the faces to be planed at the bottom of the slot are only ½ inch in width, and each of the tool bits carried by this duplex tool-holder is ⅝ inch wide, so that the tools may be fed straight down the sides of the slot to finish both these side faces and the bottoms, no horizontal feed movement of the tool-holder being necessary. A similar tool is used for taking the finishing cut. This piece of work is 31 inches long and weighs 150 pounds.

Particular attention is called to the fact that the clearance space at each end of the slot is quite short, and that there is a solid metal obstruction against which the tool would strike, if the control of the stroke could not be depended upon to prevent the occurrence of such an accident. Hence, the accurate stroke control which is available on a machine of this kind is one of its useful features in performing this operation. On this job, it is required to plane the slot within limits of ± 0.0005 inch, and to complete this operation with such a degree of accuracy, the production time is one hour per crank.

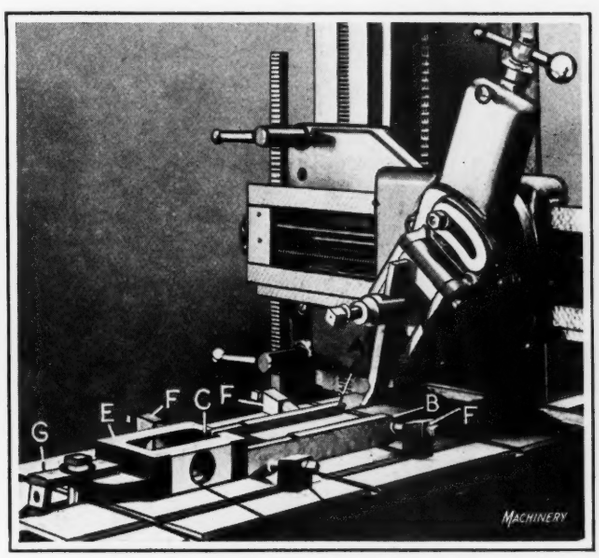


Fig. 3. Finish-planing the Inclined Side of a Dovetailed Bearing for the Slide of a Lathe built by the Automatic Machine Co.

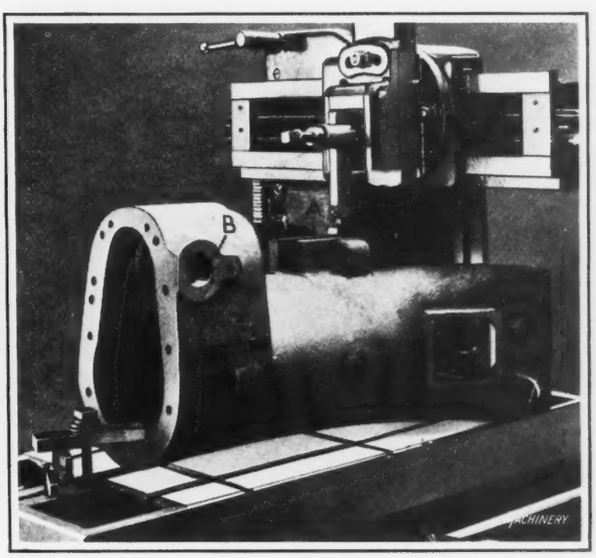


Fig. 4. Finish-planing the Valve Stem Guide in a Gas Engine Cylinder Casting. Four Other Faces are rough- and finish-planed

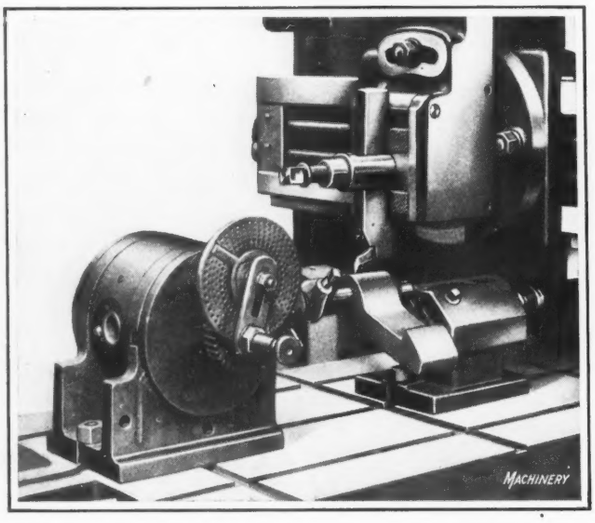


Fig. 5. Finish-planing a Cylindrical Surface with a Diamond-point Tool, to which the Work is fed by a Rotary Movement

Planing Slide for Taper Threading Lathe

In the performance of planing operations, it quite frequently happens that there are several surfaces to be machined on the same piece of work. When such work is of considerable length and the surfaces to be planed are relatively short, it would not be economical to operate the planer on a length of stroke that would provide for reaching all of the different surfaces. Too much time would be lost through having the tool "cut air," which is the term frequently applied by planer operators to the non-productive period of the stroke. Fig. 3 illustrates the use of a Coulter open-side shaping planer in the Automatic Machine Co.'s plant, for handling a job on which there are several short surfaces to finish on a single piece, and for the performance of the required operations, use is made of the stroke adjustment that is provided on this planer, and of the provision made for regulating the position at which the table reciprocates back and forth under the cutting tool.

On this job, the work is a slide casting for an automatic taper threading lathe, and the operations to be performed consist of planing the two inclined sides and the bottom of dovetailed bearing *A* and the top *B* of the work at this point, planing the sides and bottom of slot *C* and planing the face of a boss *D* at each side of the work; also, the top face *E* of the enlarged section of the work has to be planed. In order to save time that would be lost through employing an excessive length of stroke, the stroke adjustment is employed to first provide for taking cuts over the dovetailed bearing *A* and the top face *B*; then, both the length of stroke and the position of the table are changed, so that the work will reciprocate back and forth under the tool to provide for planing opening *C*, bosses *D*, and top face *E*. This possibility of adjusting both the length and position of the stroke without disturbing the work saves time and danger of inaccuracy due to incorrect resetting of the job.

Method of Clamping the Work

In so far as the actual planing operations are concerned, there is nothing particularly unusual, and the same is true of the method of setting up the work. It will be noticed that four stops *F* are set in T-slots on the planer table, and screws carried by these stops apply pressure to fingers or so-called "butters," which are inclined downward, so that they not only apply side pressure but are also effective in preventing the work from rising from the table. A strap *G* at the end of the work serves the double purpose of holding down the casting and preventing the pressure of the tool from causing it to shift laterally on the table.

In conformity with usual practice, care is taken to have the dovetailed bearing *A* and the slot *C* planed so that they are centrally located in relation to the outside of the work. For this purpose, the casting must be set up exactly parallel with the line of table travel, which is accomplished by gaging from the edge of the table; and then, the positions of the tools are regulated for taking successive cuts, so that the various surfaces will be properly located after performing the finish-planing operation. All horizontal surfaces are rough-planed with diamond-point tools, and finished with square-nosed tools 7/16 inch in width. Side tools are employed for rough- and finish-planing the vertical faces, and suitable dovetailing tools perform the rough- and finish-planing operations in the bearing, as shown in the illustration. On this job the work is required to be accurate to gages, and the total time for setting up and planing all of the surfaces which have been mentioned is 1½ hours.

Planing Pads on a Gas Engine Cylinder

A statement was made in the introduction to this article that crank planers are especially adapted for the performance of small and medium sized work, but in certain cases it will be found advantageous to plane quite large castings or forgings on a machine of this kind. A case in point is illustrated in Fig. 4, where the cylinder for a 7½- by 9-inch gas engine is set up to provide for planing the faces of five small pads, two of which are shown at *A* and *B*. The close proximity of some faces to be planed to shoulders on the work makes this an undesirable job for the planer, especially in view of the fact that it is impossible to string up a number of castings with a view to expediting production. As only one casting can be planed at a time, the small crank planer has an advantage over a larger type of machine for reasons previously mentioned.

As compared with a shaper of standard design, the advantage of the crank planer is that the work can be placed directly upon the table, instead of requiring a special cradle fixture. Handled on the Coulter open-side shaping planer, the set-up is quite simple, consisting merely of strapping the casting down on the table. The location of this work for planing is very simple, and will be readily understood from the illustration, in conjunction with the foregoing descriptions of other jobs. Diamond-point tools are used for roughing the planed surfaces, and a 7/16-inch broad-nosed

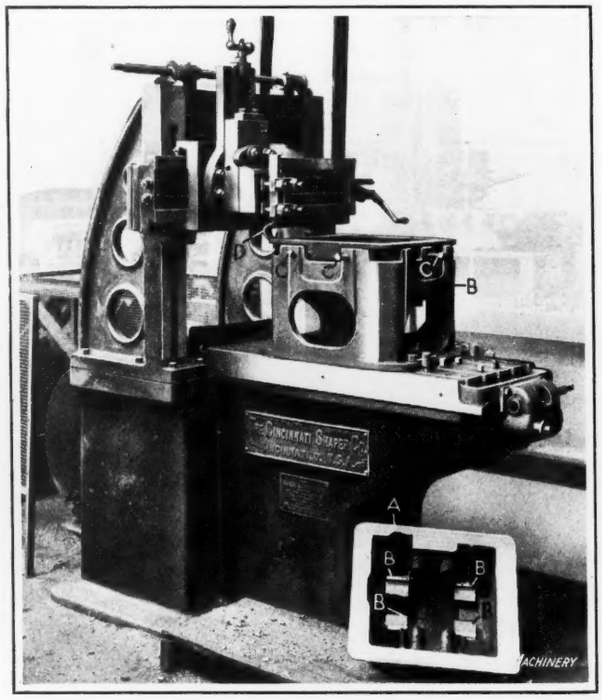


Fig. 6. Fixture for holding Avery Tractor Engine Frame for Planing Operations on Top Flange and on Bosses inside Frame

tool for taking the finishing cuts. A square-nosed slotting tool 1 inch wide is used for taking the roughing cut, and a similar tool for finishing the slot *A* for the valve stem guide, as shown in Fig. 4, these tools being of the proper width for finishing this slot at a single downward feed movement. The total time for performing the planing operations on one of these cylinder castings is one hour.

Planing a Carrier Latch-cam

Fig. 5 illustrates the way in which a pair of index-centers may be used on the Coulter open-side shaping planer to provide for the performance of a planing operation, where it is required to form a cylindrical surface. The work shown on this machine has previously been roughed out from solid stock, and is here illustrated during the process of finishing the cylindrical surface with a diamond-point tool, using the index-centers for continuously rotating the work as it reciprocates back and forth under the tool. This finishing operation requires fifteen minutes, and the present example will give the reader an idea of the utility of this machine for handling unusual operations, when suitable fixtures are employed to supplement the standard movements provided on the machine.

Planing Frames for Avery Tractor Engines

At the Avery Co.'s tractor engine plant in Milwaukee, Wis., there are frame castings to be machined which are of the form shown in the foreground of Fig. 6. These castings have a flange *A* that has to be planed, and there are also four brackets *B* which have to be faced on their vertical and horizontal surfaces, these brackets being located inside the casting at a distance of several inches below the face of flange *A*. If it were simply necessary to face off the flange, any experienced mechanic would regard this as a typical job for a planer or a planer type of milling machine; but owing to the necessity of also finishing brackets *B*, the planning department decided to handle the entire job on a crank planer built by the Cincinnati Shaper Co., of Cincinnati, Ohio.

A machine of this type is peculiarly adapted for working on the four brackets inside the casting, owing to the accurate stroke control that can be obtained. Also, as only one casting can be set up at a time, a crank planer has ample capacity for the job, and does not occupy a large amount of floor space without giving any additional return in the way of a higher rate of output. Hence, it is better adapted than a planer for performing an operation of this kind. As it was considered desirable to machine the surfaces of brackets *B* on the crank planer, the face of flange *A* is also planed while the work is set up, thus saving the time of making a second setting, which more than offsets the greater productive capacity that would be secured through finishing the flange *A* on a planer, where a string of pieces could be set up to pass successively under the planer tool. It will be seen that a fixture is provided on the crank planer for holding the work, this fixture being of the so-called box form, so that the casting may be dropped into place and supported by the under side of flange *A*. Clamping is accomplished by means of screws *C* which extend through the wall of the fixture near the top and engage the sides of the casting.

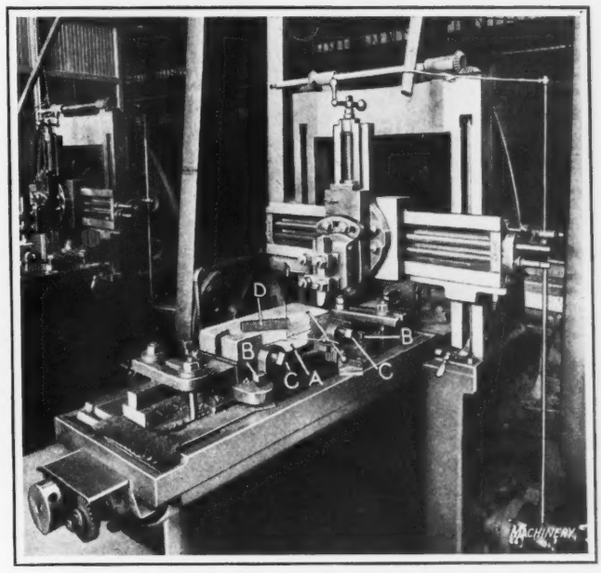


Fig. 8. Use of the Crank Planer in Chicago, Rock Island & Pacific Railway Shops for planing Locomotive Shoes and Wedges

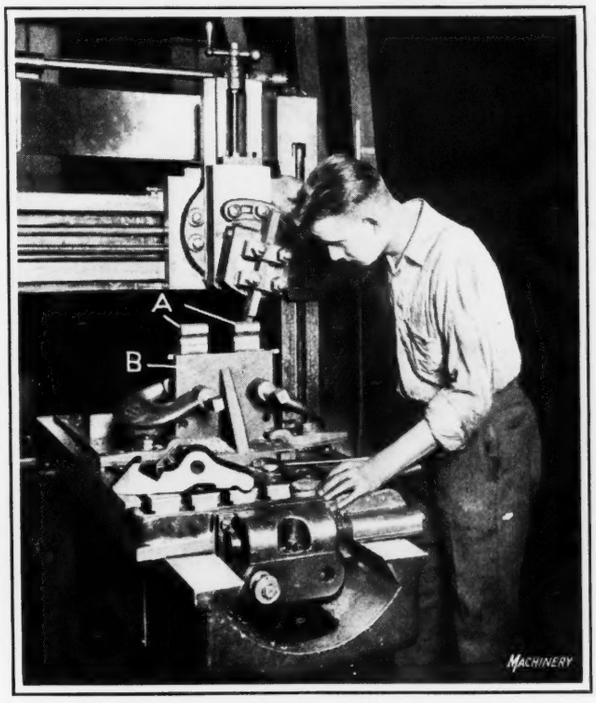


Fig. 7. Performing a Final Finish-planing Operation on Forged Nickel Steel Latches, after completing Preliminary Work

There is nothing unusual about the actual operations performed on these castings. On flange *A* a round-nosed tool is used for taking a roughing cut, and the finishing cut is taken with a square-nosed tool *D* of the gooseneck form, which enables a very smooth finish to be obtained. A roughing cut is taken at a speed of 45 feet per minute with a feed of 3/16 inch; and for the finishing cut, the same speed is employed with a feed of ¾ inch, the amount of metal removed by the finishing cut being 0.015 inch. The same sequence of operations is performed under similar conditions on the horizontal and vertical faces of brackets *B*, except that an unusually large and stiff tool is employed, which extends down sufficiently from the tool-block on the rail head of the crank planer, so that it can reach the surfaces that are to be planed. Large heavy tools of this kind are stiff enough to operate without leaving chatter marks on the work. On this job the rate of production is approximately twelve pieces in an eight-hour day.

Machining Forged Nickel Steel Latches on the Crank Planer

At the Johnston & Jennings Co.'s plant in Cleveland, Ohio, Cincinnati crank planers are used for the performance of various machining operations involved in the execution of contracts for the quantity production of finished forgings. In Fig. 7 is shown an operation incident to the manufacture of a certain type of latch made of forged nickel steel. In making these pieces, the method of procedure is to first forge and then plane on the crank planer a strip of the required form, which is next cut up transversely to make the latch blanks. These blanks then have their hubs turned

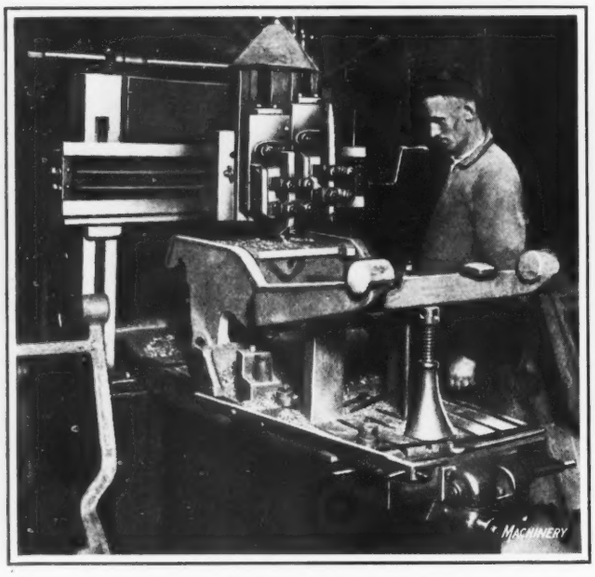


Fig. 9. Use of the Crank Planer by the Chandler & Price Co. for handling a Production Job

and bored, after which they are returned to the Cincinnati crank planers for the finishing operations. In the illustration, it will be seen that two latches *A* are held on an angle fixture *B* by means of C-clamps, to provide for beveling the two corners at one end of each latch. Evidently, the efficient performance of such an operation requires the crank planer to be worked on a short stroke, in order to reduce to a minimum the idle period which occurs between the performance of each cutting stroke and the return of the table to its starting position.

Planing Shoes and Wedges on the Crank Planer

In railway machine shops where locomotive engines are being overhauled, one operation of frequent occurrence is the machining of the shoes and wedges that hold the driving-boxes in place between the jaws of the engine frame. Men who are familiar with this work know that the shoes and wedges are employed to provide an adjustment that takes up side play between each driving-box and the frame. In the performance of such maintenance work on engines, the fitting of these members involves laying out the shoes and wedges to fit properly between the refinished driving-box and the jaws of the engine frame, so that the correct adjustment will be obtained.

In Fig. 8 is shown a Cincinnati crank planer at the Chicago, Rock Island & Pacific Railway's shops at Silvis, Ill., where it is used for planing shoes and wedges. Before being sent to this machine, each piece of work has been carefully laid out in the manner described, and during this process, three locating points are center-punched in chalk marks *A*, two at one side and one at the opposite side of the work. Then, when the piece comes to the crank planer, it is set in position and leveled up with a surface gage, using these center-punch marks as reference points, so that the work can be leveled by means of screws *B* provided for that purpose at each corner of the fixture. The work is held in the fixture by screws *C* that engage it at the sides, and it will be noticed that the fixture is secured to the planer table by straps, an end-stop being furnished to support the thrust of the tool. In the performance of this operation, the steel castings are planed with a cut ¼ inch deep, at a speed of 28 strokes per minute, the rate of feed being 1/16 inch per stroke. Gage *D* is set the proper distance from the center-punched mark to the planed top surface of the work, and shows when the piece has been finished to the correct size.

Planing Printing Press Platens on the Crank Planer

In Fig. 9 is shown a 28-inch widened pattern crank planer built by the Cincinnati Shaper Co., that is equipped with two tool-heads, one of which carries the roughing and the other the finishing tool. This machine is employed upon the planing of platens for printing presses. These pieces of work vary in size, but the largest requires the full 28 inches capacity between the housings of the crank planer on which the job is handled. It is a piece of this size which is shown in the accompanying illustration, and the production figures that will subsequently be quoted refer to the machining of such work.

In the performance of the rough-planing operation on the work, the tool is first fed down to depth and then across the piece. It is followed by a finishing tool which is fed down to depth, thus finishing the edge at one side, then across the work, and finally the tool is once more fed down on the opposite side to finish the left-hand edge of the work. In performing the finish-planing operation, the cross-feed is approximately 0.125 inch per stroke.

For rough-planing, approximately ¼ inch of metal is removed at the same rate of feed. For the performance of both roughing and finishing operations, the machine is operated on an average of twenty-eight strokes per minute. As the finished surfaces of the edges are only about 2 inches deep, downward feed in most cases is operated by hand, although power feed can be used for this purpose. The minimum amount of metal is removed by the finishing cut, as it is required to get as perfect a surface as possible. Even minute inequalities are reflected in the printing; consequently, the work is carefully tested in the inspection department to assure having a good bearing, as proved with a surface plate and red lead. The average size of the surface to be planed on these pieces is 12 by 22 inches, and the average production of castings of this size is 13 in an eight-hour working day.

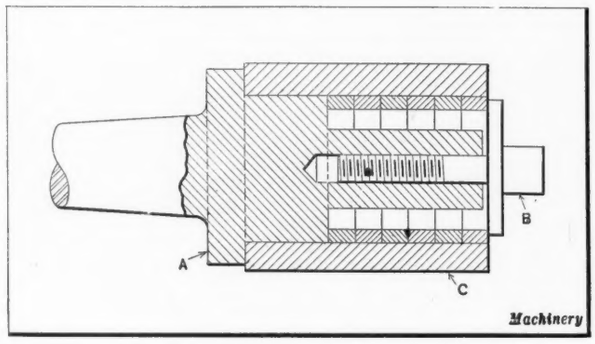
* * *

PISTON-RING CHUCK

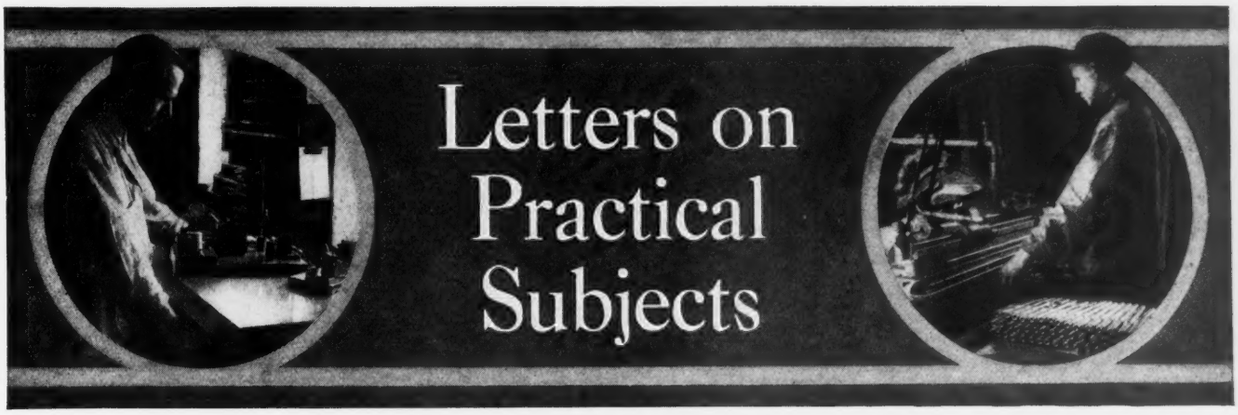
By HARRY MOORE

The piston-ring chuck here shown was provided with a taper shank so that it could be held in the spindle of a cylindrical grinding machine. This chuck was used with excellent results in performing grinding operations on the peripheries or surfaces of the rings which bear against the cylinder walls. The end of the arbor or chuck *A* was turned as shown, and tapped to receive the tightening screw *B*. The sleeve *C* for locating the rings concentric with the machine spindle was made of sufficient length to cover six rings when seated on the shoulder of the chuck as shown in the illustration.

The rings are pressed into locating collar *C*, one by one until they are all in place, then the screw *B* is inserted and tightened, after which sleeve *C* is removed, leaving the rings clamped in place, concentric with the spindle, ready for grinding. A slight taper or chamfer was given the end of the bore in sleeve *C* to facilitate the insertion of the rings, and the outside of this member was knurled in order to afford a better grip for twisting or wringing it off the piston-rings.



Piston-ring Chuck with Centering Collar



MAKING A RELIEVED GEAR-CUTTER ON A MILLING MACHINE

Twenty racks of 10 pitch, each having 16 teeth, were required to be cut in 2-inch round bars. The pitch line was 0.6625 inch below the outside surface of the bar thus necessitating the use of a special cutter of large diameter, to permit cutting to the required depth without the arbor interfering with the work. Only one cutter large enough for the work was available, and this was required on regular work. As the racks were urgently needed, the delivery of a gear-cutter from the cutter manufacturer was out of the question, so far as the job in hand was concerned. However in less than a day and a half, not a mere cutter, but a five-toothed hob, of ample diameter, was made from a fine quality of high-speed steel and placed at work on the rush job. This hob was properly relieved for grinding on the face in the regular way. The manner in which the hob or cutter was made is described in the following:

Two blanks were turned up, and the first one was gashed or fluted and then cut with the cutter in stock, on the milling machine, employing the set-up shown in Fig. 1. The hob *E*, Fig. 2, produced in this way of course had teeth of an internal or inverted form. After hardening and grinding, this hob was placed on the milling machine spindle. The second blank (which was fluted at the same time as the first) was put on the arbor of the dividing head, as shown in Fig. 1. The hob milled in this operation is shown at *F*, Fig. 2. This hob has teeth of the same form as those of the standard cutter, and was therefore the one employed in cutting the racks. The hobs and arbors employed are shown in Fig. 2. Arbor *A* is the cutter-arbor used in the milling machine spindle. The blanks, while being cut and relieved, were held on arbor *B*, which was inserted in the dividing-head spindle. It will be noticed that this arbor has an eccentric part *C*, on which the blank is placed; also that there is a small locating pin *D* near the outer edge of the large flange, at the lower side. This pin is used for locating the successive teeth of the hob during the relieving operation.

In performing the relieving operation, the blank is placed on the eccentric arbor, where it is located by the pin previously referred to and held in place by a nut on the end of the arbor. The cutting and relieving of the tooth form are performed simultaneously, by turning the dividing-head crank until one tooth is cut through to the next flute. The relieving is accomplished by the throw, or upward travel, of the blank resulting from the eccentric mounting of the blank on the arbor. The amount of relief may be governed by positioning the arbor in the dividing head. When one tooth is cut, the blank is loosened and set around by hand for the next tooth, this operation being repeated until the teeth are all cut.

Springfield, Vt. O. S. MARSHALL

ROLLING RACK TEETH

A number of white metal racks of 12 diametral pitch were required for some small special machines. These racks were 12 inches long by ½ by ¾ inch below the pitch line with a shroud 1/16 inch on each side of the teeth. It was originally planned to cut the rack teeth in the usual way and then form the shroud by screwing plates to the sides of the rack. A horizontal milling machine was available for this work, but as it was not equipped for cutting racks and as a rack-cutting attachment could not be obtained at once, it became necessary to devise some other method of producing the racks in order to deliver them within the specified length of time. The method employed was that of rolling the teeth instead of milling them, and this was found to give satisfactory results.

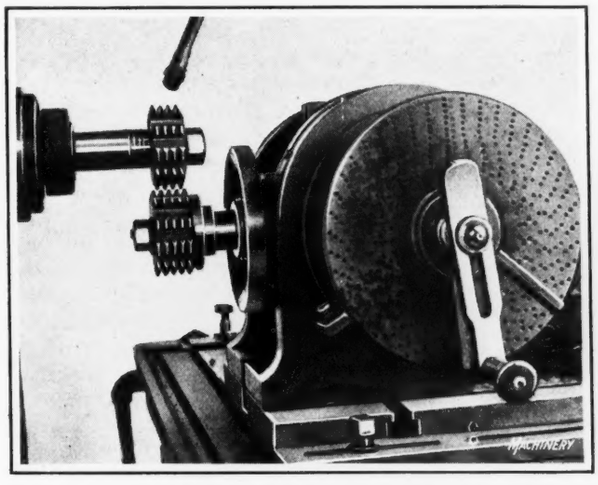


Fig. 1. Milling Machine Set-up for milling Relieved Gear-cutters

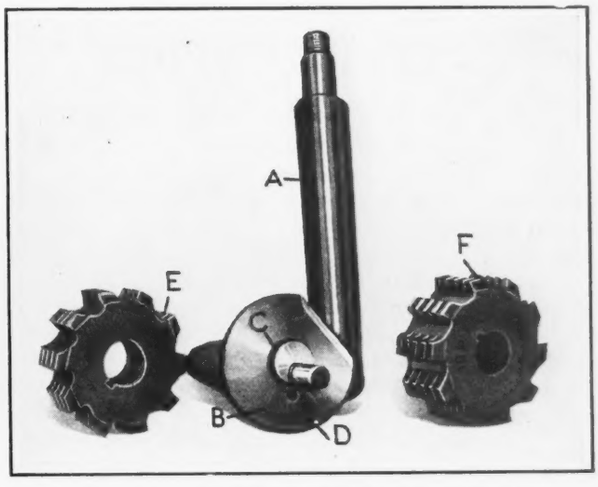
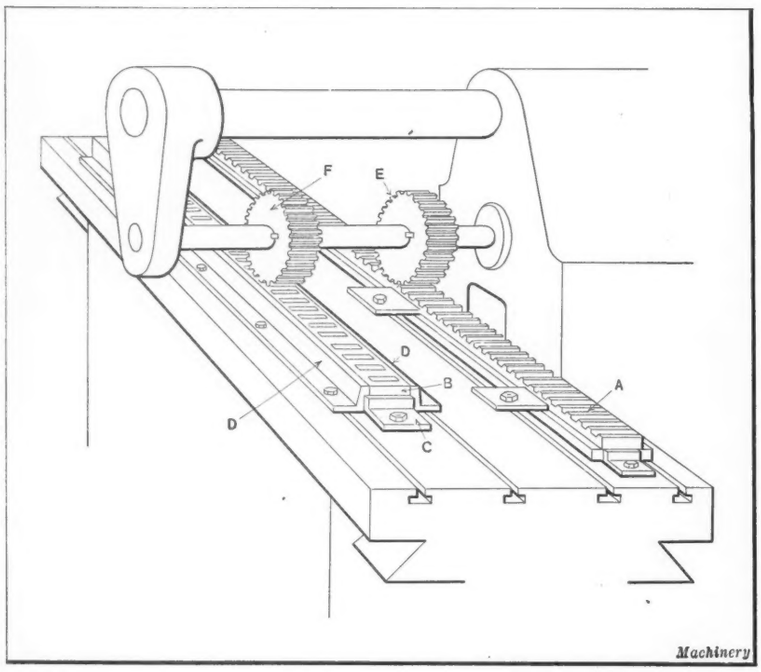


Fig. 2. Arbors and Cutters used in Set-up shown in Fig. 1



Milling Machine equipped for rolling Teeth in Soft Metal Bar

This was accomplished by the use of the fixtures shown in the accompanying illustration, which were mounted on a universal milling machine. By this method it was possible to complete the racks within five days instead of twenty days—the time required by the method first considered. The actual time taken in rolling the rack teeth was one day, the other four days being spent in making and setting up the tools. The set-up on the milling machine was made as follows: The rack *A* taken from an ordinary 8-inch lathe was set parallel with the milling machine table and securely bolted to it, wedges being used at both ends to prevent it from slipping on the table. The white metal bar *B*, to be rolled, was held securely to the table by angle-plates *D*, which were also set parallel with the table. These plates prevented the metal from spreading during the rolling operation, and the pieces *C* were provided to prevent the bar from becoming elongated when the die member was in operation.

To an ordinary milling machine arbor were keyed the timing gear *E*, which was of the same pitch as rack *A*, and the die member or gear *F*. This made a positive drive between the timing gear *E* and rack *A*, thus enabling motion to be transmitted to gear *F* by a feeding movement of the table. The die member *F*, being of the same pitch diameter as the timing gear, allowed blank *B* to be rolled beneath it at the correct speed. It was necessary to have a deep tooth for the timing gear and rack, so that they would be well meshed before the teeth of gear *F* came in contact with, or exerted pressure on, the white metal bar *B*. The timing gear *E* and rack *A*, which was of 6 diametral pitch, were found satisfactory in this respect, as the rack to be rolled was of 12 diametral pitch.

The back-gear of the milling machine was disconnected, leaving the arbor free to revolve. The power feed was then connected with the table, so that when the table moved forward it caused gear *E*, in mesh with rack *A*, to be revolved which, in turn, caused die member *F* to roll over the surface of bar *B*. Pressure was then applied by slightly raising the table at each forward and backward movement until the required depth of tooth was obtained. In rolling the rack teeth, some of the metal below the pitch line was naturally pressed up or made to flow above the pitch line to form the top of the tooth. Although it was not tried, there would seem to be no reason why rack teeth could not be rolled in soft metals such as brass. It would also be possible to roll herringbone, single helical, and other forms of teeth in the same manner.

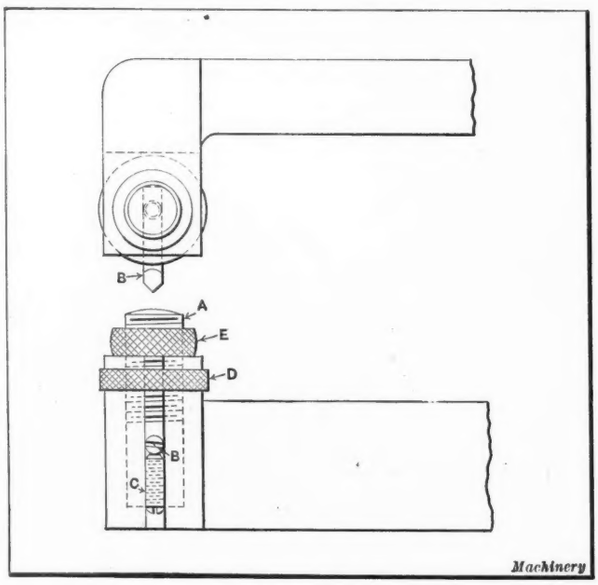
Cleveland, Ohio C. F. GEORGE

CENTERING TOOL FOR LATHE

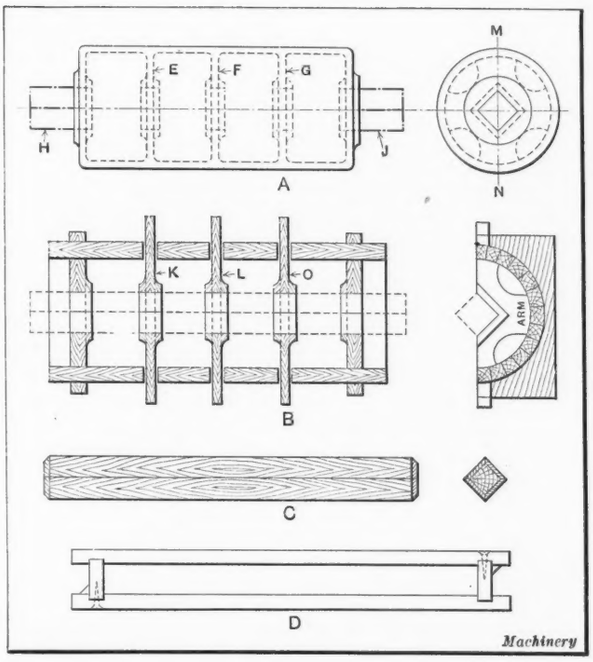
The tool shown in the accompanying illustration was designed for centering work held in the chuck jaws or on the faceplate of a lathe preparatory to drilling. With the ordinary centering tool or centering bit such as is usually held in a V-block in the toolpost, the operator is obliged to loosen or tighten the toolpost screw in order to obtain the fine adjustment necessary to center the tool properly. This method requires considerable time, and it frequently happens that the final adjustment is so imperfect that a small tip is left by the tool where a sharp conical shaped center is desired. If the centering operation is to be followed by the use of a large drill, the tip left in the center will be worn down or broken so that little harm is done, but if a small drill is to be used, a true and clean center must be produced to start with; otherwise, the drill will break or be thrown off center by the side pressure caused by the tip.

The adjustable tool-holder shown is made of 1⅛- by ¾-inch stock. The end of the holder is bent at right angles, and a hole drilled through this end to take the sliding member *A* in which the centering tool is held. This piece is threaded for about half its length as indicated, and is drilled for the 3/16-inch drill-rod centering tool or bit *B*, and tapped for the clamping screw *C*. A slot cut across the face of the holder accommodates the knurled nut *D*, which is threaded to fit part *A*. Another knurled nut *E* is also threaded to fit this piece. A vertical slot in the face of the holder permits the tool bit to be moved up and down by adjusting knurled nut *D*. When centering work, the tool-holder is clamped in the toolpost in the approximate centering position. Nut *E* is then backed away from the holder so that the tool can be raised or lowered by means of nut *D*. When located in the required centering position, nut *E* is tightened, thus locking the tool in place.

Rosemount, Montreal, Canada HARRY MOORE



Adjustable Centering Tool



Casting for Coiler-spool, and Core-boxes used in making the Casting

CASTINGS FOR SHEET-METAL COILER-SPOOLS

Spools for coiling sheet metal as it comes from the rolls may be made from maple-wood or from either steel, iron, or aluminum castings. Many spools designed for this work have proved unsatisfactory, due either to their failure to withstand the pressure exerted on them, their excessive weight, or the great expense entailed in their production. To overcome these objections, the writer designed the coiler-spool shown at *A* in the accompanying illustration. This spool is intended for use in coiling sheet brass as it comes from the rolls. It consists of a single hard iron casting that requires no machining. The casting must, therefore, be straight and uniform in diameter throughout its length. There must be no seams or pores on the face of the casting, and it must be light in weight to facilitate handling. It must also have sufficient strength to withstand the binding pressure of the sheet metal during the process of coiling and the tension of the sheet as it leaves the rolls. Some idea of the pressure which a coil-spool of this kind is required to withstand may be gained from the fact that a cast-steel spool, 7½ inches in diameter and 14 inches long, with a wall thickness of ¼ inch, collapsed ¼ inch in diameter when in use, an amount which made it unsuitable for sheet-metal winding.

Referring to the illustration at *A*, the square holes through the ends of the casting and through arms *E*, *F*, and *G* are required to be in line, and a loose fit over a 2-inch square shaft. To meet these requirements, it is evident that considerable care must be taken in the designing of the patterns and core-boxes, as well as in the making and drying of the cores, the making of the mold, and the setting of the cores in the mold. The pattern as designed has the same exterior form as the casting shown at *A*, with the exception that core-prints *H* and *J* were added at the ends, as indicated by the heavy dot-and-dash lines. The pattern is, of course, split lengthwise on line *MN*. The core is made in two parts, and the core-box for making the two halves that form the core is shown at *B*. The pieces *K*, *L*, and *O* are evenly spaced and set into slots cut into the sides of the box. These pieces and the ends of the box are cut away, as indicated, to receive the square piece shown at *C*. This piece is made of wood and is the same size as the auxiliary core formed by the core-box *D*.

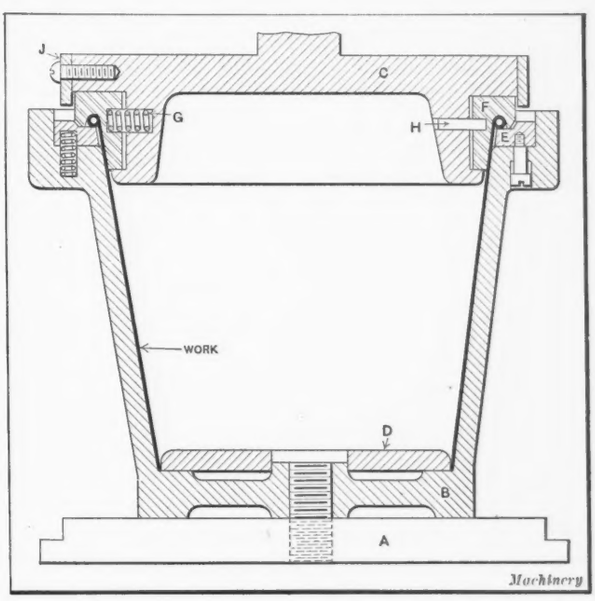
When making the core, the arms *K*, *L*, and *O*, and the piece *C*, are put in place in the box, and sand is filled in up to the top of the box, and struck off. The piece *C* and the pieces *K*, *L*, and *O* are then removed, thus completing the half-core. The openings left by the piece *C* and the arms *K*, *L* and *O* are filled with "black sand" to prevent a "drop" in the core-sand when it rests on the drier plate. When the two half-cores are baked and ready for assembling, the square core produced from core-box *D* is given a coating of paste and placed between the V-grooves in the half-cores, after which the three parts are bound together with wire, wound in the grooves which form the arms. One point which should not be overlooked in making the cores is the fact that the square holes through the center of the casting, must be in line. Therefore, the drier plates on which the half-cores are placed for drying, should be perfectly flat.

Kenosha, Wis. M. E. DUGGAN

WIRING DIE FOR WATER PAILS

Wiring operations on comparatively high pieces, such as water pails, are generally accomplished on long-stroke power presses on which the maximum distance between the lowest point of the punch and the top of the die is sufficient to permit the work to be inserted in the die, or else the operation is performed on a press having a much shorter stroke but which is provided with a die that can be slid from under the punch to enable the insertion of work. A die for wiring water pails by the latter method is shown in the accompanying illustration, the sliding of the die back and forth under the punch being accomplished by pulling or pushing slide *A* by hand. Die *B* is correctly located relative to the center of punch *C* for an operation by slide *A* coming in contact with a stop.

It will be noted that the pail is of the type in which the bottom is a separate piece from the tapered shell and that the wiring operation is performed prior to the assembly of the bottom sheet. On account of this procedure plate *D* is provided to prevent the bottom edge of the pail from curling during the wiring of the top edge. Prior to inserting a shell in the die, a previously bent wire is placed on ring *E*, the latter being in a raised position due to the action of the coil springs beneath it. The height to which this ring is raised is governed by the heads of special screws operating in counterbored holes in die *B*. After the shell has been placed in the die and the latter slid under the punch, the wiring operation is performed on the downward stroke of the press ram as sections *F* mounted on punch *C*



Die with Sectional Punch for wiring Water Pails

come in contact with the top edge of the pail and force the latter and ring *E* down until the bottom of the ring rests on the die.

There are twelve sections *F*, each of which has sufficient clearance on the punch to permit a slight radial movement. Each section is provided with a coil spring *G* and a guiding pin *H*. The springs force the sections outward, so that the desired pressure will be exerted on the work when the sections come in contact with the latter, while pins *H* prevent the sections from moving circumferentially around the punch. Ring *J* serves to hold the sections on the punch and fixes the maximum expansion. In dies of this kind, it is well to make the wiring groove in each of the sections about 1/64 inch larger in diameter than the diameter of the wire plus twice the metal thickness of the pail. This permits a free and easy curling operation.

Toledo, Ohio J. BINGHAM

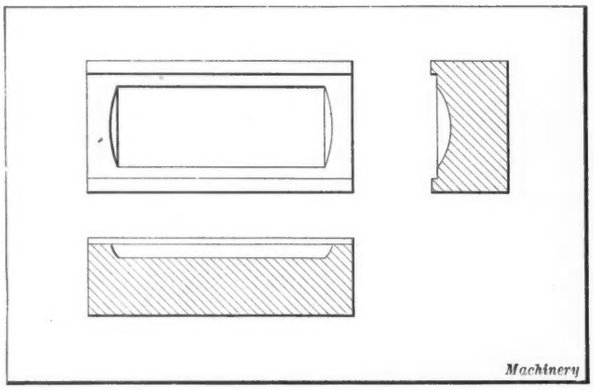


Fig. 1. Mold with Concave Surface for molding Glass Plates

SHAPER FIXTURE FOR MACHINING A CONCAVE SURFACE

The foreman of a small experimental shop recently received rush orders for a number of parts similar to that shown in Fig. 1. These parts were to be made of cast iron and were for use in molding glass plates—a class of work that requires a highly finished mold, free from scratches, tool marks, or other irregularities that might be reproduced upon the glass. Upon investigation, it was found that the lathes and milling machine on which the parts would ordinarily be machined were in operation on work that could not be removed. A shaper, being the only available machine, was finally equipped as shown in Fig. 2, for performing the work.

A steel bar *A*, 2 inches square, with a drilled and reamed hole for stud *B* was bolted to the side of the machine over the slide ways by means of two cap-screws, one of which is shown at *C*. The holes for these cap-screws were so spaced that the screws could be inserted in the threaded holes provided for the gib-screws. A ½- by 1-inch machine-steel piece *D*, with a hole drilled and bell-mouthed as shown in Fig. 3, to allow free movement of part *E*, was made and inserted in the slot of the toolpost.

Stud *B* was turned on a bench lathe, being made a snug fit in the hole in bar *A*, so that it would oscillate freely with no play, when in operation. An oil-hole *H* was drilled in bar *A* to provide means for lubricating the bearing surface of the stud. The small end of this stud was threaded and a standard nut and washer employed to hold it in place as shown. A tapped hole was also provided for a standard set-screw *F*, which holds part *E* in place. Part *E* was made from a bar of drill rod, and was hardened and ground on the cutting end. When assembling the attachment, care is taken to adjust *E* so that the distance from the cutting point to the center of stud *B* as indicated by dimension *R* will equal the radius of the curved surface of the work. The stroke of the shaper head is first roughly adjusted in the usual way, a finer adjustment afterward being obtained by raising or lowering the head of the machine.

Fig. 3 shows how the point of the tool forms the curved surface in the work by the oscillating motion imparted to it by the forward and return stroke of the shaper ram. The dotted lines in this illustration show the positions of parts *E* and *D* at the end of the forward and return stroke, respectively. A hole was drilled and tapped in the side of the clapper-block and a small cap-screw inserted to hold the clapper-block down tight. As this arrangement causes the tool to drag on the back stroke, it is necessary to adjust the feeding pawl carefully so that it will act only upon reaching the extreme end of the return stroke; otherwise the continual backward drag would soon break the cutting edge or dislodge the tool. Such good results were obtained with this attachment, that little hand polishing was required to finish the work.

J. E. L.

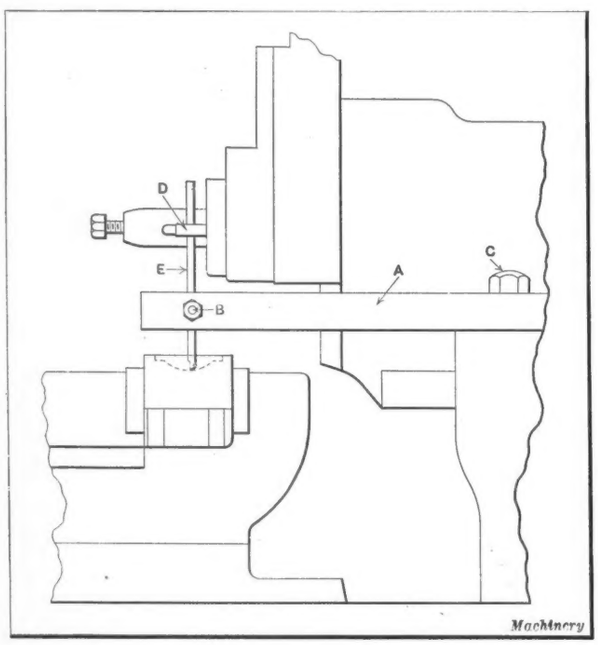


Fig. 2. Shaper equipped to machine Curved Surface of Mold shown in Fig. 1

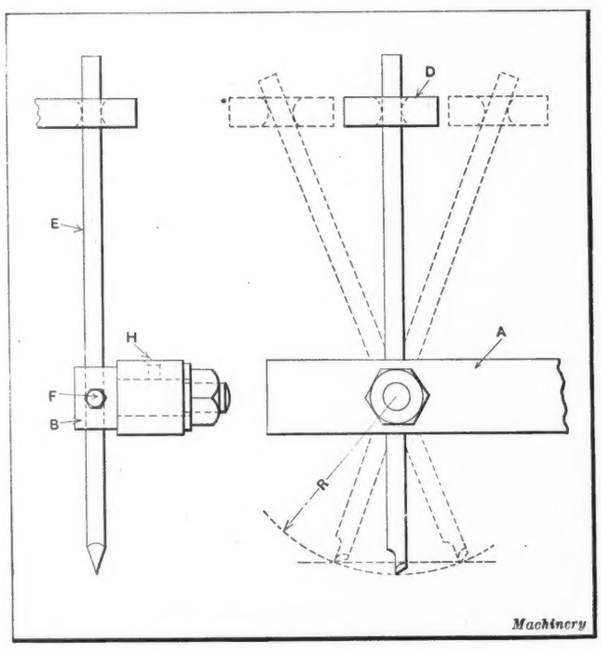


Fig. 3. Diagram showing Principle of Operation of Shaper Attachment

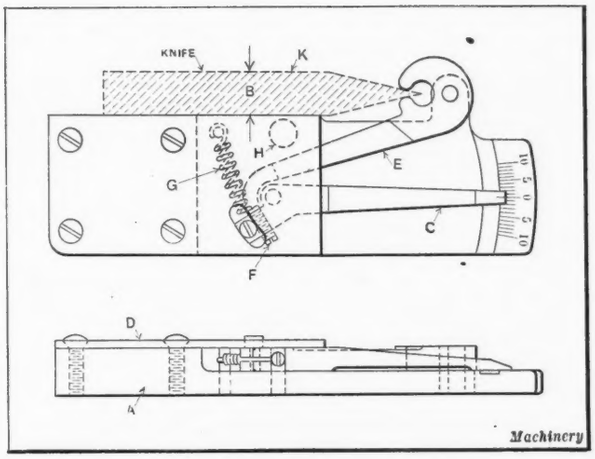


Fig. 1. Gage for testing Position of Knife Edge in Respect to Sides of Blade

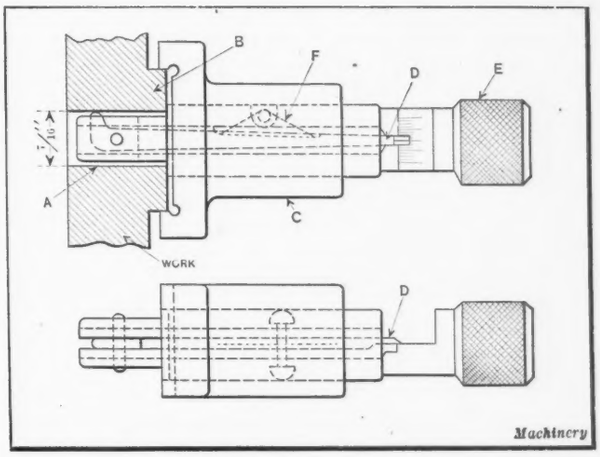


Fig. 2. Gage for testing Concentricity of Hole and its Position in Tongue

INDICATING GAGES

In Fig. 1 is shown an indicating gage for determining whether or not the cutting edge of a knife blade is located in a central position in respect to its sides. The cross-sectional shape of the knife *K* to be tested is indicated by dotted lines. The cutting edge of the knife in this particular case must be within the limits of plus or minus 0.002 inch of the center of the blade. To grind this type of knife without the aid of an indicating gage would be rather difficult, as there is no means of easily determining the amount to be ground from each side of the blade. With the aid of the indicating gage, however, the grinding becomes a comparatively simple problem.

While the gage shown is used for gaging knife blades of the shape indicated, it is not limited to this particular type of work, but may be used for gaging other work of a similar nature. The thickness *B* of the work governs the size of gage required. The base *A*, gaging lever *E*, and indicating lever *C* are made of tool steel. Cover *D* is also made of tool steel and is ground to a thickness of 3/32 inch. A master knife of the same shape as the work is made from pack-hardened machine steel for use in adjusting the gage after it has been assembled. Pack-hardened machine steel screw *F* is used for adjusting the indicating lever to zero. Spring *G* is made of 0.010-inch music wire, and stop-pin *H* which limits the travel of arm *E*, is also made of pack-hardened machine steel.

The gaging lever *E* measures 2¼ inches from the fulcrum point to the point of contact with screw *F*, held in indicating arm *C*, and ½ inch from the fulcrum point to the point of contact with the knife. This gives a lever ratio of 4½ to 1. The indicating lever *C* measures 2½ inches from the fulcrum point to the reading edge and ¼ inch from the fulcrum point to the point of contact of screw *F* on gaging lever *E*, thus giving a ratio of 10 to 1, making a total ratio of 45 to 1. Thus, if the knife blade has been ground incorrectly, and the edge is 0.001 inch off center, the indicating lever will move 0.045 inch at the reading edge. This means that the 0.001-inch graduations on the scale must be spaced 0.045 inch apart.

Another type of indicating gage for testing the concentricity of a reamed hole and its position in a tongue is shown in Fig. 2. The 7/16-inch reamed hole *A* is required to be concentric with, or at the center of, tongue *B* of the work. The holder or base *C*, the shell or plunger *E*, and the indicating lever *D* are made of tool steel. The indicating lever measures 2⅝ inches from the fulcrum point to the reading edge, and 3/16 inch from the fulcrum point to the point of contact in the reamed hole. This gives a ratio of 14 to 1. Thus if the hole is not concentric with the tongue and is exactly 0.001 inch off center, the reading edge of the indicating lever will move 0.014 inch. The 0.001-inch graduation marks on the scale must, therefore, be spaced 0.014 inch apart. A spring *F* made of 0.010-inch music wire is located in the plunger *E*, as shown, the ends of the spring resting in a groove cut in the side of indicating lever *D*.

Natick, Mass. EDWIN V. CHRISTENSEN

DRILLING MACHINE ATTACHMENT FOR FACE-MILLING OPERATION

The faces *A* of the inner hubs of some gray iron castings, such as shown in Fig. 1, were successfully milled on an upright drilling machine by the use of the attachment shown in Fig. 2. This attachment, consisting of a fixture and milling head, should be of particular interest to designers, as the principle upon which it is designed can be readily embodied in the design of tool equipment for similar work. A noteworthy feature of the fixture is the method of locating and holding the work, which permits rapid loading and unloading.

No clamps or similar holding devices are used. The work is simply held in place by pins *C*, no particular attention being paid to centering, as this is taken care of by the pilot *E* on the milling head. This pilot automatically enters the hole *F* before the cutters come into action, thus locating and holding the work in the proper position during the milling operation. To unload the fixture, it is simply necessary to raise the milling head until the end of pilot *E* clears the top of the work and withdraw pins *C*, so that the casting will drop out of place.

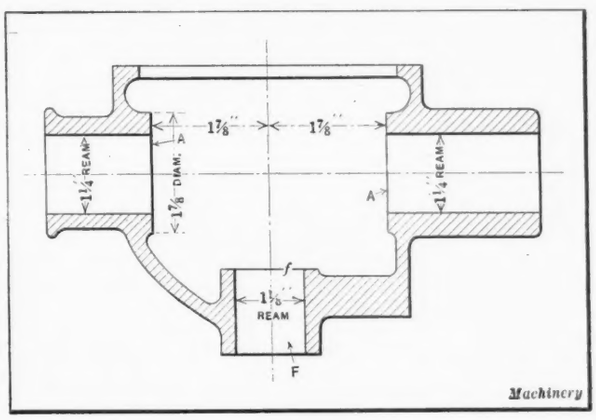


Fig. 1. Gray Iron Casting machined at A by Equipment shown in Fig. 2

The fixture consists of two main parts, part *A* being the milling head proper and *B* the base of the work-holding and guiding fixture. The fixture is of the so-called "open-front" box type and is well ribbed, and of heavy construction. Body *B* is made

of cast iron, and all other parts such as pins *C* and bushings *D* are of hardened and ground steel. Flats *G* are milled on pins *C*, and headless set-screws located at the front of the fixture hubs, and extending through the bushings, act as stops which prevent the pins from being completely withdrawn from the fixture. This obviates the possibility of the pins dropping out of place and being lost in the tool-crib. The upper portion of the fixture, which guides the milling head, is of rectangular shape. A cap, not shown, is fitted to the front face. This cap has hardened steel guide plates on each corner similar to those shown on the corners at *H*, in contact with part *A*. These plates are the only parts of the fixture which come in contact with the milling head.

The milling head is of simple but rigid construction. The body *A* is made in one piece from a machine-steel forging. The cutters *S*, which are of special design, are made from high-speed steel. They are keyed to arbor *I* by standard keys, not shown in the illustration. All gears, bushings, etc., are hardened, ground, and carefully fitted in place to insure accuracy and long wearing properties. The driving shaft *J* has a taper shank which fits the drilling machine spindle and is doweled in place to prevent it from falling out due to the weight of the milling head.

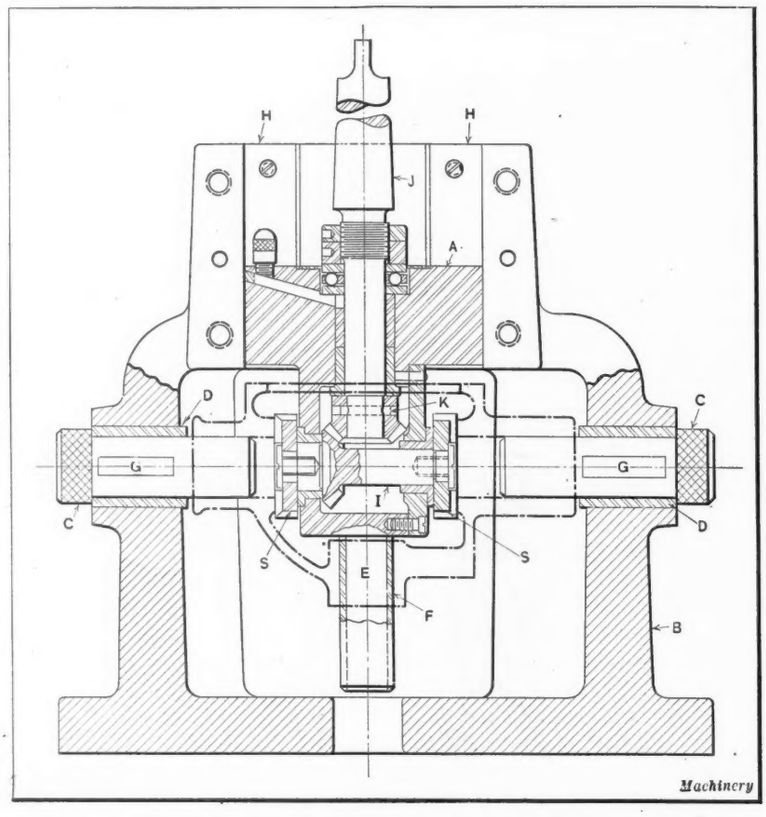


Fig. 2. Drilling Machine Attachment for milling Faces A of Casting shown in Fig. 1

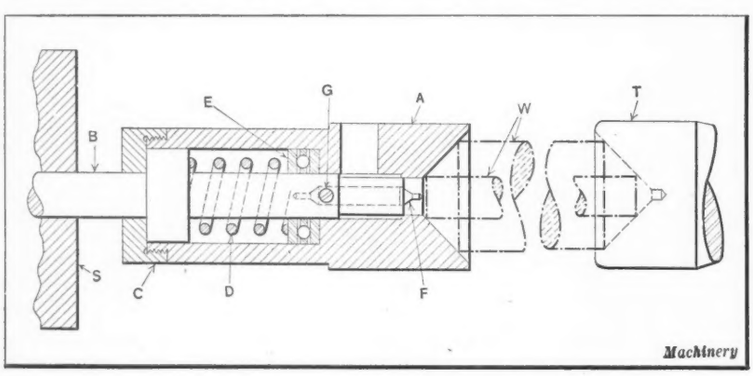
As there is always a possibility of the operator feeding the cutters into the work with such force that either the cutters or gears might be damaged, the driving gear is fastened to shaft *J* by means of a soft cold-rolled steel pin *K*, which is of such diameter that it will shear off when the milling head is overloaded or improperly handled. The pin can, of course, be easily replaced. This precaution was found necessary as the fixture illustrated was used by semi-skilled operators. The equipment described in the preceding was designed by the writer and built in the factory of Gustave Lidseen, Chicago, Ill., where it has given entire satisfaction for a long period of service, so that there is nothing experimental or doubtful about it.

Chicago, Ill. C. J. HUEBER

BENCH LATHE ATTACHMENT FOR CENTERING PLUG GAGE BLANKS

The centering device illustrated was designed to provide a means of rapidly centering blanks for taper plug gages, to be used in testing Briggs pipe threads. The centers in these blanks were required to be of uniform depth. The fulfillment of the latter requirement enabled the blanks to be threaded in such a way that the thread would start at the same point on the taper plug of each gage. Referring to the illustration, part *A* is a female center which is free to rotate about arbor *B* held in the spindle *S* of a bench lathe. Threaded collar *C* retains the female center on the arbor, and spring *D*, acting against the center *A* through the thrust bearing *E*, serves to keep the work in line with the centering tool at the beginning of the cut. The centering tool *F* is locked in the spindle by the set-screw *G*, and can be adjusted to center the work to any required depth. The end of spindle *B* is grooved to provide for the removal of chips from the end of the work, which is shown by dot-and-dash lines at *W*. The female tailstock center shown at *T* has grooves cut on the inside or centering surface so that it will prevent the work from turning. This center is held in a lever-operated tailstock.

The operation of the device is as follows: With the tailstock set at the proper distance from the headstock, the operator places a plug blank in line with the two centers and brings the female tailstock center toward the headstock, thus clamping the work in place between the two centers. This operation centralizes the work, and a further movement of the tailstock lever in the same direction forces the head center *A* to slide to the left on spindle *B*. This brings the tool into contact with the work. The pressure on the tailstock lever is continued until the end of spindle *B* comes in contact with the end of the work, thus gaging the depth of the center. The spring forces the work against the grooved inner cone of the female tailstock center so that it will remain stationary during the centering operation. The simplicity of the device is obvious, and the speed of operation made possible by eliminating the time required in clamping the work by means of the devices usually employed makes it adaptable for the performance of all classes of light centering work. B. S.

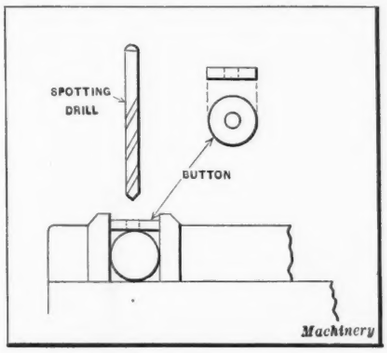


Bench Lathe Attachment for centering Plug Gage Blanks

SHOP AND DRAFTING-ROOM KINKS

DRILLING HOLES THROUGH ROUND SHAFTS

In the accompanying illustration is shown a convenient method of drilling holes through the center of round shafts. The button in the upper right-hand corner is used to locate the spotting drill, while the shaft is held in position by vise jaws. The buttons can be made in several sizes to correspond with the diameters of standard shafting. They should be about 0.001 inch smaller than the shafting, so that they can be removed without disturbing the piece clamped in the vise. The holes in the different buttons can all be made for the same size spotting drill. The buttons should, of course, be removed after spotting, and a drill of the required size used to drill the hole.

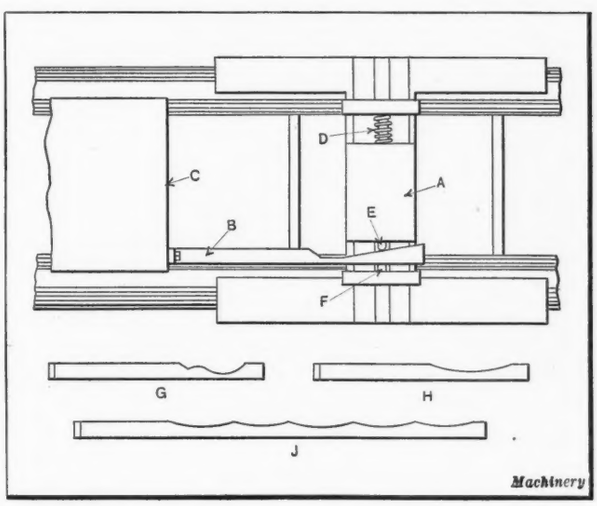


Drilling Holes through Round Shafts

Brooklyn, N. Y. HOWARD HOUSE

TAPER-TURNING ATTACHMENT FOR LATHE

The taper-turning attachment shown in the accompanying illustration is adapted either for taper turning or for use in turning bars to irregular shapes. The attachment consists of a templet *B* which actuates tool-slide *A*. The left-hand end of this templet is bent up and attached to the headstock *C*. A spring *D* keeps pin *E* in contact with the templet as the carriage moves back and forth. Pin *F*, driven into a screw-cutting stop attached to the carriage supports the straight side of the templet. When using this attachment the cross-feed screw is, of course, removed. By attaching different templets in place of templet *B* it is possible to turn bars to irregular shapes. For instance, the templet shown at *G* is designed for use in turning machine handles, and the templet shown at *H* is used for turning pulleys, while the one shown at *J* was designed for use in turning a four-step cone pulley.



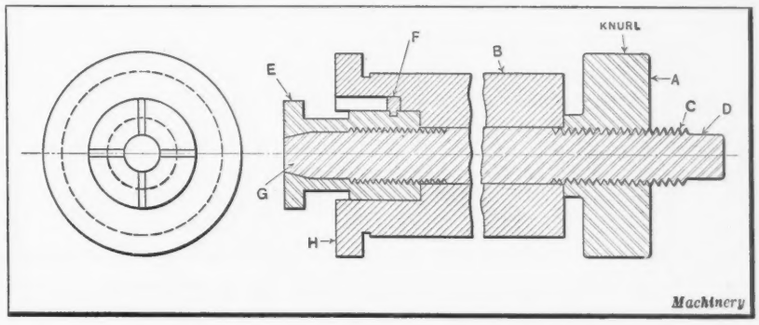
Taper-turning Attachment for Lathe

Providence, R. I. JOHN T. SLOCOMB

CUTTER-HOLDING DEVICE FOR UNIVERSAL GRINDER

In the accompanying illustration is shown a cutter-holding device that the writer has found useful when grinding milling cutters having acute angles. It was designed for use on a small universal grinding machine, and is of such simple construction that it requires little explanation. Bushing *B* is made to fit the grinding machine headstock, and was inserted in place of the original bushing, which was bored to take a No. 1 Morse taper. The cutter to be ground is mounted on expansion arbor *E*, fitted in bushing *B*. A key *F*, driven into part *E*, fits into a slot or keyway cut in bushing *B*, and prevents *E* from turning.

A wrench which fits the squared end *D* of screw *C* is employed to expand bushing *E* so that it will grip the cutter. After arbor *E* has been expanded, knurled nut *A* is screwed up until the cutter is held tight against face *H* of bushing *B*. Expansion arbor *E* is spring-tempered, and end *G* of spindle *C* is casehardened. Though designed primarily for holding milling cutters while grinding their cutting edges, this device can also be used for holding various kinds of work for different machining operations.



Device for holding Milling Cutters while grinding their Cutting Edges

Millersburg, Pa. ROY A. DRESSLER

* * *

FINANCING FOREIGN CREDITS

One of the well-known machine tool building firms in this country is extending credits to customers in France and Belgium upon a plan which might later be employed also in other foreign countries. According to this plan, responsible concerns pay 4 per cent of the purchase price monthly during the first year, 3½ per cent monthly during the second year, and 2½ per cent monthly during the third year, the total payment thus amounting to 120 per cent of the cash price, allowing for interest on the credit extended. Any installments paid in advance at any time are subject to a 10 per cent discount. If, on account of more favorable exchange, the customer wishes to pay up at any time, he can secure for himself a substantial saving by the discount allowed. In one of the countries mentioned, the agent of the American firm referred to is able to pay cash for the machines in the first place, and is then selling the machines to his customers upon the terms mentioned.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, June 14

AT the time of writing, production in almost every branch of the engineering trade is virtually at a standstill. This condition is largely due to the present coal dispute, although there are other causes that influence the situation considerably: Production costs are at a high level, and unbalanced exchange rates enable Continental producers to offer goods in the home markets at prices below those quoted by British makers. For example, it is stated that German street car rails can be delivered in Sheffield at below the actual cost of the coal required to make them in that city.

Price Reductions

So far as the machine tool trade is concerned an effort to stimulate new business has been made by a general reduction in prices of from 10 to 15 per cent. Thus far, however, the results obtained by this action are hardly worth recording, and it is probable that still further and more substantial reductions will have to be made before anything of a material nature develops. Machine tool manufacturers will find it extremely difficult to make greater reductions in the price of their products at this time, as the reductions that have been made thus far have had to come out of their own profits, owing to the fact that iron and steel prices remain at the same level, and, unfortunately, cannot be reduced under present conditions. Iron and steel is costing the producer more than it can be sold for, and authorities state that unless the price of coal is brought down to something like £1 a ton at the mine, production cannot be resumed on a satisfactory basis. Nevertheless, there is a strong undercurrent of optimism that matters will work out all right in the end, and judging by the inquiries received during the last week or so, a general improvement in the situation is expected before long.

In the small tool trade, prices of late have depreciated considerably, and manufacturers are now quoting twist drills at 47½ per cent less 12 per cent to wholesalers, below list prices. Most other kinds of small tools are quoted less 30 per cent and 30 per cent and 12 per cent below list prices to retailers and wholesalers, respectively. The automobile industry is much more active than it has been, the demand for low and medium priced cars being particularly evident.

Magneto Industry

Protective measures are being taken by the British Government to safeguard what are regarded as the key industries, and magneto manufacturers are anxiously watching developments. There will hardly be any difference of opinion as to the policy of safeguarding so vital an industry, the development of which in this country is due entirely to the war. Formerly we produced probably not more than 5 per cent of the magnetos used here, and Germany supplied most of the remaining 95 per cent, though some other countries made attempts to obtain a portion of the trade. British manufacturers are now, however, in a position to produce for themselves all the magnetos the country is likely to need for some time to come.

Overseas Trade in Machine Tools

The official reports of the total overseas trade in machine tools for the first four months of this year show that the imported tonnage is settling down toward pre-war level, while the exported tonnage is well maintained at far above pre-war level. The value per ton of the imports has been strongly maintained during the fall in quantity, but a sharp decline in value took place in April. This may prove to be a passing occurrence, but it more probably indicates a break in the high prices that have been paid to the United States manufacturers. Actually for the first four months of 1921, the total weight of imported machine tools was 1728 tons, the total value of which amounts to £430,224 (about $107,555 present exchange) which is equal to a ton value of £249 ($62.25). During the same period, exported machine tools amounted in weight to 9509 tons, and their value is placed at £1,383,704 (about $345,926) which equals a ton value of £146 ($36.50). The ratio of imports to exports for the period referred to is: imports, 100 tons; exports, 550 tons; imports, £100; exports, £322; value per ton of imports, £100; and value per ton of exports, £54.

As compared with March the reports for April show that the imports of grinding machines have increased by 90 per cent, while exports have dropped by half. Imports of milling machines remain about the same, though exports in this class have dropped by 80 per cent. Drilling machines remain on practically level terms, but in lathes a drop of 35 per cent is noted in exports. There is also a drop of 2 per cent in the export of planers and shapers; other classes of machines are practically unaltered, except presses, and punching and shearing machines, where a drop in exports of about 45 per cent is noted.

Labor Conditions

A serious, though not yet critical, situation has arisen in connection with the drastic wage cuts proposed by the employers to come into operation on June 16. A deputation to the Ministry of Labor representative of thirty-three unions, including the Amalgamated Engineering Union and the Boilermakers Union, has asked for an inquiry. The cuts proposed are, for time-workers, a reduction of 6s ($1.20) per week and the cancellation of the 12½ per cent increase granted in 1917; and for piece-workers, a reduction of 15 per cent and the withdrawal of the 7½ per cent increase granted in 1919. Members of the deputation explained that these percentages work out at 15s 11d (about $3) per week reduction for skilled time-workers, anything from this figure up to 24s ($4.80) per week for skilled piece-workers, 14s ($2.80) for semi-skilled men, and 13s ($2.60) for unskilled men. A strike or lock-out now, as a result of these demands, would mean the complete stoppage of the engineering trades, and a further meeting between the employers and the men's representatives is to be arranged by the Ministry of Labor.

International Standardization

A conference of the secretaries of the various standardizing organizations at present in existence has recently been held in London. Secretaries from the United States, Norway, Holland, Canada, Belgium, Switzerland, and Great Britain were present. The object of the conference was the exchange of ideas looking toward the establishment of closer relationship, and from this point of view it was eminently successful. Each secretary gave a brief report of the general organization of the work in his own country, the methods adopted in arriving at the standards, as well as the principles followed to insure their adoption.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Sellers 35-foot Boring and Turning Mill. William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa..... 1065
Bevington Wire Straightening and Cutting Machine. Bevington Metal Stamping Co., 1545 E. 18th St., Cleveland, Ohio 1066
Webster & Bennett Duplex Boring and Turning Mills. Alfred Herbert, Ltd., 50 Church St., New York City... 1067
Cincinnati Fixture Dogs. Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio..... 1068
Simplex Measuring Irons. Simplex Tool Co., Woonsocket, R. I. 1068
Black & Decker Portable Electric Grinder. Black & Decker Mfg. Co., Baltimore, Md. 1068
Geometric Self-opening Die-head. Geometric Tool Co., New Haven, Conn. 1069
Besly Double-spindle Ring-wheel Grinding Machine. Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill..... 1069
Bath Micrometer Internal Thread Gage. John Bath & Co., Inc., 8 Grafton St., Worcester, Mass..... 1070
Keeler Cylinder Reboring Machine. Central City Machine & Tool Co., Syracuse, N. Y..... 1070
Stamets Gantry Type of Drilling Machine. William K. Stamets, Jenkins Arcade Bldg., Pittsburg, Pa..... 1070
Improved Pratt & Whitney Measuring Machine. Pratt & Whitney Co., Hartford, Conn..... 1071
Sacrey Oil-grooving Machine. Philadelphia Engineering & Machine Co., 1130 Race St., Philadelphia, Pa..... 1071
Simplex Vertical Drawing-board. Simplex Tool & Instrument Co., 820 N. Third St., Camden, N. J..... 1071
Grand Rapids Tap and Drill Grinding Machines. Grand Rapids Grinding Machine Co., 29 Ottawa Ave., Grand Rapids, Mich. 1072
Colburn Railroad Boring Mill. Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio..... 1072
Jones Boring, Drilling, and Milling Machine. Jones Machine Tool Works, Philadelphia, Pa..... 1073
Brown & Sharpe Machinists' Tools. Brown & Sharpe Mfg. Co., Providence, R. I. 1074
Landis Cylinder Grinding Machine. Landis Tool Co., Waynesboro, Pa. 1075
Pratt & Whitney "Trus-form" Snap Gages. Pratt & Whitney Co., Hartford, Conn. 1076
Twist Drill Grinder. Oliver Instrument Co., Adrian, Mich. 1076
Houston, Stanwood & Gamble Lathe. Houston, Stanwood & Gamble Co., Cincinnati, Ohio..... 1077
Pearson-Scott "Iron Man." Pearson-Scott Co., 1523-1529 E. Washington St., Indianapolis, Ind..... 1078
Precision Grinding Wheel Truing Machine. Precision Truing Machine & Tool Co., Cincinnati, Ohio..... 1079
Pawling & Harnischfeger Tilting and Rotary Table. Pawling & Harnischfeger Co., Milwaukee, Wis..... 1079
Landis Special Grinding Machine. Landis Tool Co., Waynesboro, Pa. 1080
Niagara Power Squaring Shear. Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y..... 1080
Anderson Gear-cutter Grinding Machine. Anderson Die Machine Co., Iranistan Ave. near Admiral St., Bridgeport, Conn. 1081
Lawrenz "Normal" Drafting Compass. E. Lawrenz, 2533 McClellan Ave., Detroit, Mich..... 1081
Wayne Drill Chuck. Wayne Tool Mfg. Co., Waynesboro, Pa. 1082
Attachment for Oliver Pattern Milling Machine. Oliver Machinery Co., Grand Rapids, Mich..... 1082
Poliakoff Machine Shop Rule. R. Poliakoff, 709 Sixth Ave., New York City..... 1082

Sellers 35-foot Boring and Turning Mill

ONE of the largest boring and turning mills ever constructed, intended primarily for finishing mammoth castings for hydro-electric units has been built by William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa. This machine, shown in Fig. 1, has a capacity for work up to 35 feet in diameter and up to 18 feet 6 inches in height.

Bed and Table Construction

The bed of the machine is made in two sections, because if it were made in one piece its size would be such as to make shipment impossible. The main section is equal in depth to the base of the uprights and extends the length of the machine, while the second section is semicircular in shape and is bolted to the front of the main casting. The assembled bed weighs approximately 50 tons. Two annular bearings on the bed support the table and facilitate its rotation. These bearings are supplied with oil under pressure from a pump connected to the main driving mechanism of the machine. A vertical hole is bored at the center of the bed to receive a split bushing into which a tapered spindle at the center of the table is inserted. This bushing may be adjusted to eliminate lost motion or to compensate for wear, and is lubricated by oil coming from the inner of the two annular bearings. The table is also made in two castings, the diameter of the assembled table being 19 feet 10 inches, and the weight about 40 tons. It is provided on the upper surface with twenty-four radial slots, and is driven by means of a large external spur-gear ring, bolted to it.

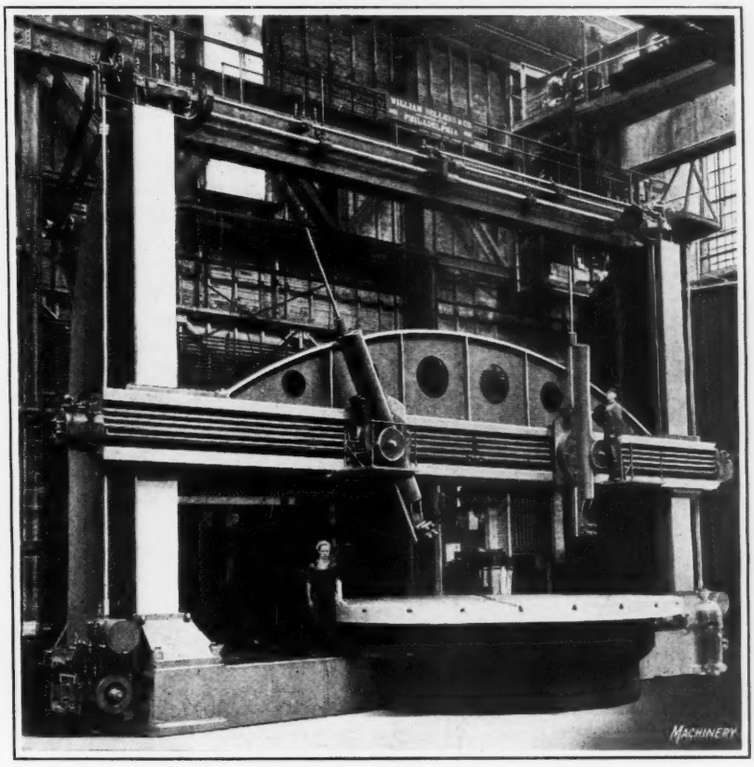


Fig. 1. Huge Boring and Turning Mill built by William Sellers & Co., Inc.

Table Drive

A 50-horsepower variable-speed motor, for driving the table and feeding the saddles on the cross-rail and their tool-slides, is placed at the back of the left-hand upright. This motor has ten speeds, ranging from 400 to 1200 revolutions per minute. From the motor pinion, power is transmitted to the table through a drive giving four speed changes. This arrangement gives a choice

of forty speeds for the table covering a range of from 0.19 to 6 revolutions per minute. The clutches for operating the various gears in the speed-change unit are controlled by levers near the motor, and all clutches are interlocking so as to prevent the meshing of two gear trains at one time. The gears are of large proportions and have cut teeth, while all shafts in the unit are short so as to eliminate shaft deflections which might result in chatter and an unsatisfactory finish on the work. From the speed-change unit, power is transmitted to the table through reduction gearing, the last shaft of which is vertical and provided with a pinion that meshes with the ring gear on the table.

Uprights and Cross-rail

The uprights are 12 feet deep at the base and have faces 24 inches in width. At the top they are tied together by means of a cast-iron cross-girt of box construction. The cross-rail is made straight at the back instead of curved as is the common design, and is clamped in position by the use of pneumatic clamps. This construction is said to provide more than ample strength at the points where the greatest torsional stresses occur. The cross-rail is clamped on each end at the back on a vee on the insides of the uprights and

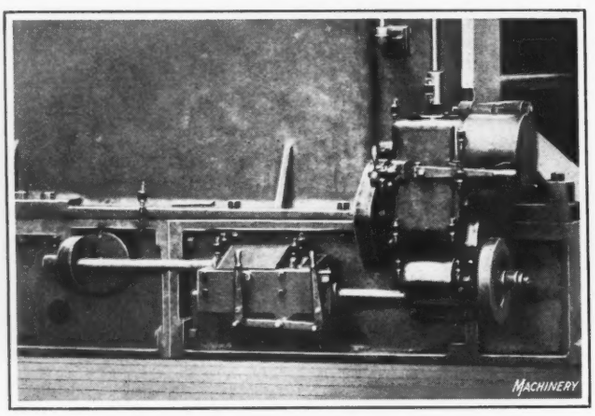


Fig. 2. Feed-change Gear-boxes on Left Side of Machine

at the front on the outsides of the uprights. A large arch-shaped girder is bolted on the top of the cross-rail to eliminate any deflection which might be occasioned by the large span of the uprights. Adjustable wedges at the ends of the girder enable the cross-rail to be made level.

Cross-rail Clamps, and Raising and Lowering Mechanism

Two clamps are provided at each of the clamping points on the cross-rail previously mentioned so that there is a total of eight clamps. These are all operated instantaneously by the manipulation of a lever on a valve situated on the right-hand upright within easy reach of the operator. The cylinders actuating the clamps are connected to the valve by flexible hose. After the cross-rail has been clamped, the air pressure on the cylinders may be released by again operating the valve lever, the clamps being so designed that they cannot loosen until air is applied in the reverse direction to that in which it was applied in tightening them. This feature is essential in pneumatic clamps for a machine of this type, because the length of the operation may necessitate the cross-rail to be clamped during a period when air under pressure might not be available. This clamping arrangement saves a large amount of time as compared with the time required for loosening a number of nuts.

The raising and lowering of the cross-rail to accommodate the work is accomplished by means of a 20-horsepower reversing motor bolted on the back of the left-hand upright, which drives a pulley on a shaft extending across the face of the cross-girt. The top of the cross-girt is accessible by means of a ladder attached to the left-hand upright, and rails are provided to afford safety to a workman when walking on the cross-girt. At the center of the cross-girt the pulley shaft is connected through a clutch to a lower shaft, which also extends the length of the cross-girt and is connected at each end through bevel gearing to a vertical screw on the uprights. The clutch is operated by means of a shaft extending from the middle of the cross-girt to the right side of the machine, from which it is connected with a lever near the bottom of the upright. By operating this lever the screws may be rotated so as to raise or lower the cross-rail, the direction of movement depending upon the rotation of the motor pulley.

Feeding Movements and Rapid Traverses

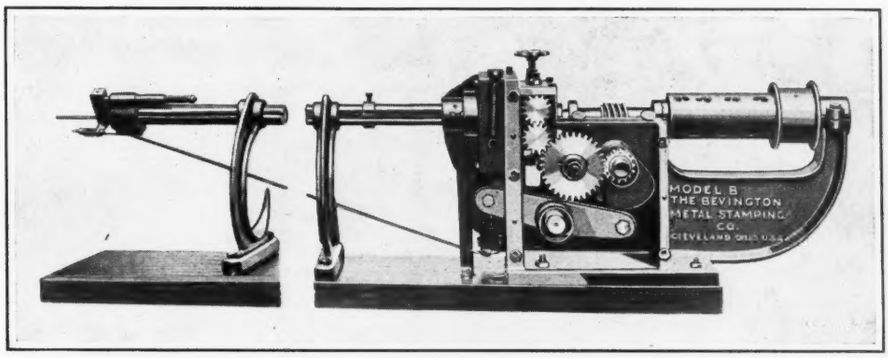
The horizontal feeding movements of the two saddles on the cross-rail, and the vertical feeding movements of the tool-slides are obtained from the table drive, and so the feeds are always in a certain relation to the table rotation. The final shaft in the speed-change unit of the table drive extends through the base at the left side, and by means of bevel gearing drives a shaft extending toward the front of the machine and into a feed-change gear-box. This arrangement is shown in Fig. 2. At the front of this gear-box a second shaft extends forward, and is connected through bevel gearing with a vertical feed-change gear-box. This second shaft also drives a shaft running beneath the base to the right-hand side of the machine where it is connected with a vertical gear-box identical with the one at the left.

A shaft extends from the top of each vertical gear-box to the top of the corresponding upright, and drives a gear in a tumbler gear unit on the end of the cross-rail. By the operation of levers at the side of either saddle, power may be transmitted either to the screw for feeding the saddle horizontally or to the shaft which drives the mechanism for feeding the tool-slide. The horizontal and vertical feeds range from 1/64 to 1½ inches per revolution of the table, the entire vertical movement of the tool-slides being 7 feet. The control shafts, tool-slide feed-shaft, and saddle screw for each saddle extend only to the middle of the cross-rail. The provision of a vertical gear-box on each upright permits the tool on one saddle to be fed at a different rate from that on the other saddle, while the horizontal gear-box on the left side of the machine is employed to change from the range of roughing feeds to the range of finishing feeds.

Rapid traverse of the saddles and tool-slides is effected by means of the motor used for raising and lowering the cross-rail. Directly in back of the vertical shaft on the left-hand upright, but hidden in the illustration by this shaft, is a second vertical shaft, which is driven at the top by the pulley shaft on the cross-girt. There is a similar vertical shaft on the right-hand upright. These two vertical shafts are also connected by gears to the tumbler gear units on the cross-rail ends and cause rapid rotation of the saddle screws or the tool-slide feed-shafts when the levers on the saddles are properly set. The saddle levers are duplicated by levers on the tumbler units, so that the point of operation is optional. The motor on the left-hand upright is operated by push-buttons on the saddles. A feature of the saddle construction is that no counterweights are required for the tool-slides, as a split nut is provided, which has a spring that constantly maintains contact on both sides of the thread of the portion of the screw in the nut. The tool-slides may also be fed by hand through the handwheels provided. It will be observed that the slides are reinforced by a tubular section in front of the guiding surfaces which furnishes exceptional resistance to tool pressures.

BEVINGTON WIRE STRAIGHTENING AND CUTTING MACHINE

The Bevington Metal Stamping Co., 1545 E. 18th St., Cleveland, Ohio, has developed the automatic wire straightening and cutting machine shown in the accompanying illustration. This machine has a capacity for wire ranging



Automatic Wire Straightening and Cutting Machine made by the Bevington Metal Stamping Co.

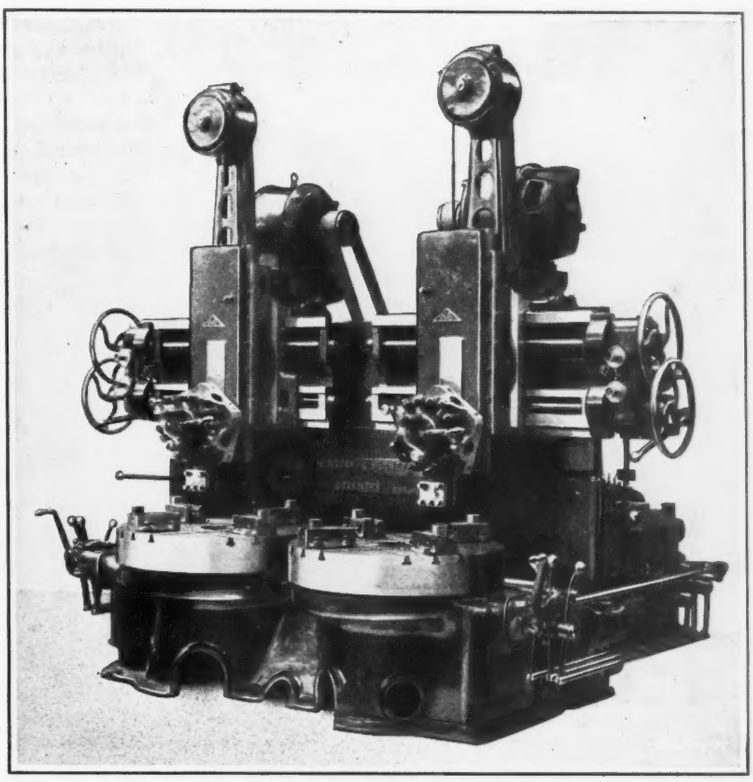
from 5/32 inch in diameter to No. 20 Washburn & Moen gage, ¾ horsepower being required for its operation. All bearings are interchangeable and made of bronze, except those for the arbor, which are ball bearings. The feed-rolls and cutting dies are made of special tool steel and heat-treated, while the straightening dies are made of either iron castings, wood, babbitt, or brass, the material depending upon the wire being handled. The interchangeable feature of all bearings renders the making of repairs a simple proposition. Bearings, cutting and straightening dies, and feed-rolls are kept in stock for immediate shipment. As the machine is provided with ball bearings, it is practically noiseless in operation. The machine is made in various lengths to suit the length of wire to be cut.

WEBSTER & BENNETT DUPLEX BORING AND TURNING MILLS

A departure from established practice in boring mill design has been introduced by Webster & Bennett of Coventry, England, their machine being of the duplex type, that is, having two tables and two boring heads fitted with revolving turrets. When the duplex table type of machine is employed, both turret heads can be fully employed at the maximum speed, the tables being quite independent of each other in all particulars, thus enabling boring and turning operations to be performed simultaneously and at correct speeds for the central bearing hole and for the outside diameter of a wheel, or for similar combinations of conditions. A very great proportion of boring mill work requires two settings, and when using a machine of the duplex type, both settings proceed simultaneously, each head being tooled for its own set of operations. Thus there is a constant flow of finished work leaving the machine, and the operator is not handicapped by an increasing pile of partly finished material surrounding his working area. These new duplex mills are made in two sizes with 20-inch and 42-inch tables.

Among the features of the design of this machine the following may be mentioned: Power is supplied to a single pulley fitted with a friction clutch, and from this pulley the drive is carried through speed-change gears. It is impossible to change the positions of any of these gears until the clutch on the driving pulley has been disengaged. Either a positive feed or rapid power traverse is instantly obtainable; and the automatic horizontal, vertical, and angular feeds are positive, reversible, and interlocked. Provision is made for holding the feed safety clutch in position by means of a powerful spring, which is set to withstand the pressure exerted by the heaviest cut that a tool will take. Any tool pressure beyond this causes the clutch to slip, and so prevents damage to the feed mechanism through accident or carelessness. The position of adjustable micrometer collars is controlled by spiral springs which, although they maintain a constant pressure on the collars, enable the operators to readily make the desired adjustment for setting tools and sizing the work by revolving the collars. There is an automatic trip motion with graduated dials, geared to the feed by means of friction clutches which are engaged or disengaged by knurled knobs at the front of the dials. When the zero mark on the dial is brought opposite the pointer, the feed motion is automatically cut out. To facilitate setting the tools over the work, rapid power traverse is provided for the turrets in all directions, and this quick movement is interlocked with the automatic feeds to avoid danger of damaging the mechanism.

All feed-screws and worms are furnished with ball thrust bearings, and the turrets are balanced by compensating springs, the tension of which is adjusted by revolving a worm-shaft located above the balance box. This tension should be such that little effort is required for moving the turret-slide either up or down by turning a handwheel. As a result, the fatigue factor is largely eliminated and the operator's efficiency is maintained constant throughout the day. An improved tool-binder holds boring-bars, etc., accurately in place without bruising them. All slides are furnished with narrow guides; and all control levers are centralized, so that they are easily accessible from the operating position. Two levers control the automatic feed and rapid traverse motions in all directions. Both the spindle bearing and thrust ring are liberally proportioned. The downward thrust is taken on a large double-coned bearing of anti-

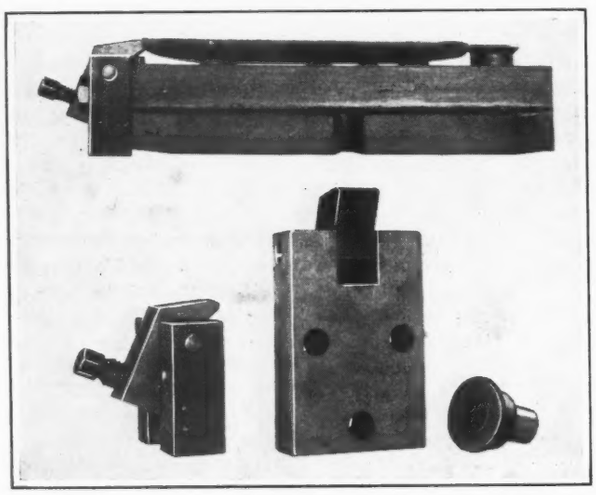


Duplex Boring and Turning Mill built with 20- and 42-inch Tables by Webster & Bennett, and sold in the United States by Alfred Herbert, Ltd.

friction metal, and with due care in lubricating, it is claimed that this bearing will last almost indefinitely. Filtered oil is supplied to all gears and bearings by means of sight-feed and other types of lubricators, all of which should be filled with a good quality of lubricating oil at the beginning of each working day. The gears are made of steel or phosphor-bronze, and all bearings are fitted with liners. The handwheels are fixed in position, and the only loose crank or spanner is the chuck key used when operating the machine. As a single pulley delivers power to each table, no countershaft is required; but if so desired, individual motor drive can be employed. Alfred Herbert, Ltd., 50 Church St., New York City, has the sales agency for these machines in the United States.

CINCINNATI FIXTURE DOGS

Special dogs have been placed on the market by the Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio, for clamping work on fixtures. The lower portion of the illustration shows two sizes of the adjustable type and one size of the stationary type, while the upper portion shows a small sized adjustable dog and a stationary one being used to clamp a part on a fixture. The adjustable dogs and holders are made of machine steel and casehardened, the stationary dogs being made of an alloy steel and hardened.

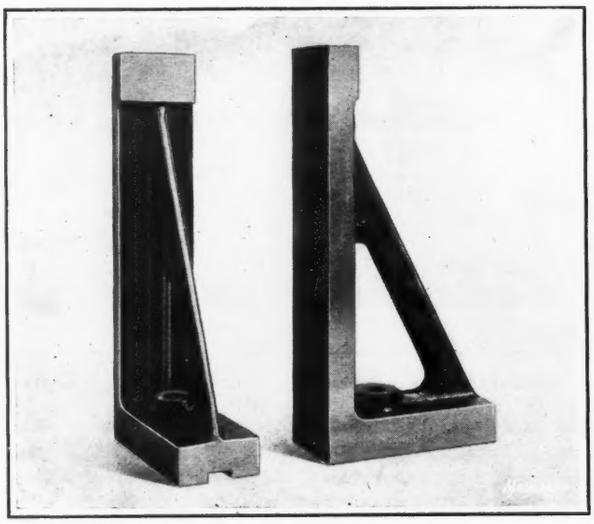


Application and Details of Special Fixture Dogs designed by the Cincinnati Engineering Tool Co.

By using these dogs for clamping work a fixture can often be designed and built cheaply, due to the dogs permitting the use of a simple casting which requires little machining; the fixture can be more easily cleaned as there are no projecting walls to retain chips; and the work can be clamped close to finished surfaces, this being especially advantageous when the work has large rounded ends as shown in the illustration. When a set-screw is used for clamping work, the point is likely to be worn eccentric, so that the set-screw tends to lift the work from the fixture instead of clamping it. The adjustable dogs positively clamp the work on the locating points, and so trouble of this kind is avoided.

SIMPLEX MEASURING IRONS

The Simplex Tool Co., Woonsocket, R. I., makes the measuring irons shown in the accompanying illustration, which are intended to facilitate many kinds of accurate machining operations. When clamped to a machine table or a surface plate by means of the hole through the bottom of the irons, they form accurate surfaces from which to measure, in the checking of work. The irons are rigidly designed and made narrow so as to occupy a minimum amount of space on the table or surface plate. They are made of close-grained iron



Machine and Surface-plate Measuring Irons made by the Simplex Tool Co.

castings, and have the front face and bottom ground accurately and square. The sides are also machined. The following sizes of irons are carried in stock: 12 by 6 by 2½ inches, and 22 by 8 by 4 inches.

BLACK & DECKER PORTABLE ELECTRIC GRINDER

A one-half horsepower portable electric grinder, which embodies all the features of the portable electric drill manufactured by the same concern, has recently been placed on the market by the Black & Decker Mfg. Co., Baltimore, Md. A pistol grip and trigger switch gives the operator entire control over the tool at all times without the necessity of shifting his hand. Although the grinder is essentially a portable tool, it is supplied with a quickly detachable base and an adjustable tool-rest, as shown in Fig. 2, to enable it to serve as a bench tool. An important feature of this grinder is the fact that it can be driven by either direct or alternating current. Forced air cooling is provided; the gears and shafts are made of chrome-nickel steel; and the housing is an aluminum alloy casting. The housing effectively protects the driving mechanism from dust and other foreign matter.

Besides the detachable base and tool-rest previously mentioned, the equipment supplied with this grinder includes two 5- by 1-inch grinding wheels, one of which is fine and the other coarse, a wire-brush wheel, and a cloth buffing wheel. With these parts, the tool can be used in automobile garages and service stations, and in machine shops and foundries, for removing dust and paint from metals, polish-

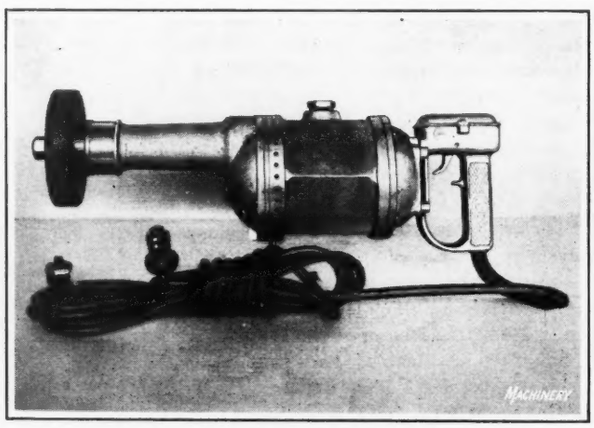


Fig. 1. Portable Electric Grinder made by the Black & Decker Mfg. Co.

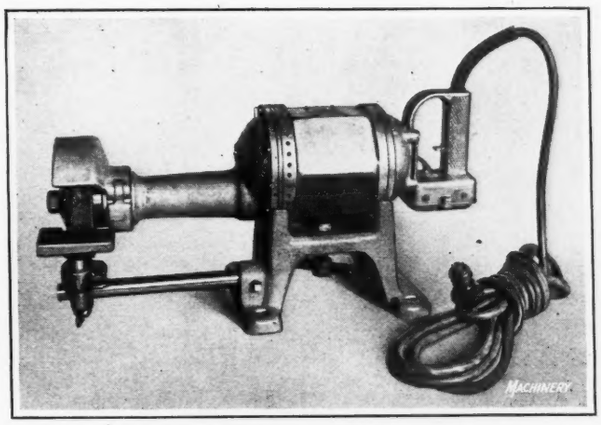


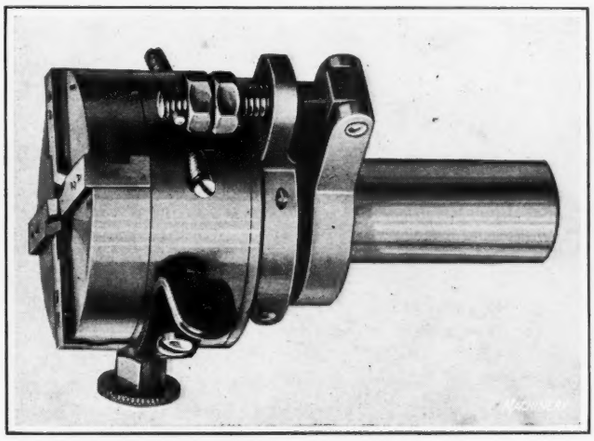
Fig. 2. Detachable Base and Tool-rest which facilitate the Use of the Portable Grinder as a Bench Tool

ing metal parts, sharpening tools, smoothing castings and welds, and cutting off rivet heads. The speed of the wheel-spindle under no load is 3200 revolutions per minute. The weight of the tool without the base is 21 pounds.

GEOMETRIC SELF-OPENING DIE-HEAD

A style D S self-opening, adjustable die-head designed primarily for use on Brown & Sharpe automatic screw machines, but which is adaptable to other machines as well, has been placed on the market by the Geometric Tool Co., New Haven, Conn. The die-head floats to suit the part being threaded, thus preventing stripping and shaving of the threads, and making a close camming of the machine unnecessary. The lever trip provided reduces the force of tripping, and accordingly lightens the strain on the threads being cut. Buffer springs allow the die-head to yield slightly when the chasers come in contact with the work, and thus assure a smooth thread from the start. The tripping point is adjusted by means of two check-nuts. Shock and wear are reduced to a minimum by a spring closing attachment, and push-buttons obviate trouble in inserting the chasers.

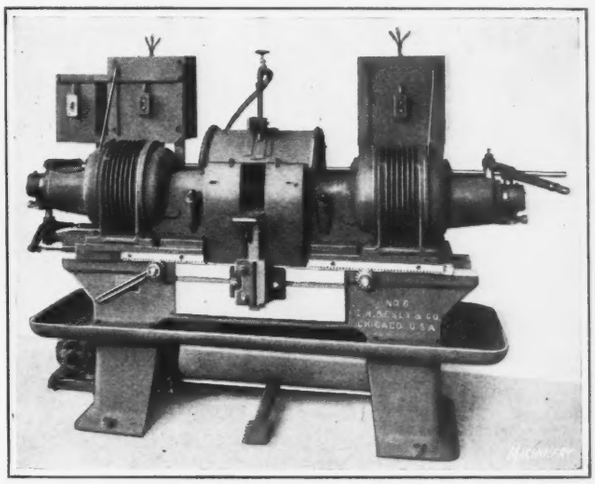
No faceplate is necessary, and so it is possible to use projecting chasers for cutting threads close to a shoulder. The chasers have long bearings in the die-head, and are supported by hardened keys which prevent tilting and a subsequent cutting of taper threads. There are four chasers in each size of die-head. The die-head is provided with a shank to fit the particular machine on which it is to be used. It is made in three sizes, namely, 5/16, 9/16, and ¾ inch. The 5/16-inch size has a capacity for work ranging from 1/16 to 5/16 inch in diameter, up to 1¼ inches long, having 18 or more threads per inch; the 9/16-inch size handles work ranging from ⅛ to 9/16 inch in diameter, up to 1¼ inches long, having 12 or more threads per inch; and the ¾-inch size is suitable for work from ¼ to ¾ inch in diameter, up to 1¾ inches long, having 10 or more threads per inch.



Style D S Self-opening Adjustable Die-head developed by the Geometric Tool Co.

BESLY DOUBLE-SPINDLE RING-WHEEL GRINDING MACHINE

A Type I direct-motor-driven double-spindle ring-wheel grinding machine, which has recently been placed on the market by Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill., is shown in the accompanying illustration. The principle of operation is to grind simultaneously both sides of a part parallel, either by dry or wet grinding. The machine is equipped with two 7½-horsepower alternating-current motors of a fully enclosed type. A push-button control is provided for stopping and starting the motors, the starters being attached directly to the motor frames. The motors are mounted on plates which slide on vees planed on top of the bed. This arrangement permits the motors to be moved longitudinally to accommodate different widths of work, the movements being accomplished by means of racks and pinions. The left-hand motor plate has an adjustment feature which makes it possible to keep the grinding wheels in true alignment.



Duplex Motor-driven Ring-wheel Grinding Machine developed by Charles H. Besly & Co.

The wheel-spindles are slid endwise through their bearings to feed the wheels to the work. These spindle movements are obtained through racks and pinions operated by either a hand- or a foot-lever. Both spindles are actuated simultaneously through a connecting-rod and lever at the rear of the machine. However, this rod may be disconnected, so that the right-hand spindle can be locked in a stationary position, while the left-hand spindle is operated to and from the work by manipulating the foot-lever. At the rear of the machine, a spring is attached to a lever that is drawn out when the spindles are moved toward the work, and when the foot- or hand-lever is released this spring causes the spindles to be returned to their starting positions. The endwise movements of the spindles are controlled by micrometer stop-screws.

The bearings are made from heavy phosphor-bronze castings which have large flanges for taking the thrusts. Hardened steel thrust collars are provided, and these are automatically oiled. The hood is centrally located on the machine, and as the hood casings are attached to the motor heads, they are moved with the motors. The top section of each hood is hinged so that it may be thrown back to enable the grinding wheels to be adjusted or changed. A T-slot is machined on the front side of the bed for attach-

ing work-rests and other fixtures, while the rear of the bed is also designed to enable such attachments to be made.

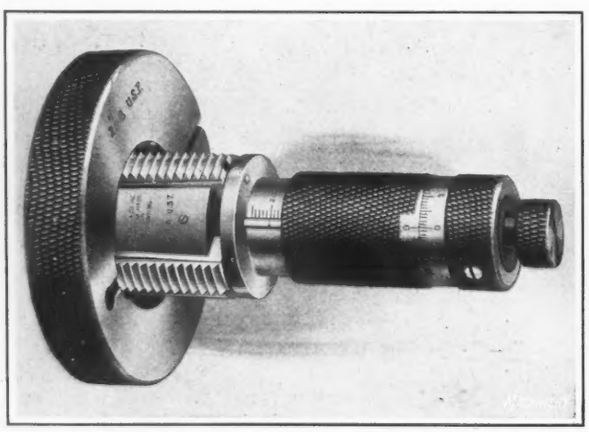
In the illustration, the machine is equipped for wet grinding and has a plain work-rest, but rocking, swinging, or sliding work-rests may be furnished. A direct-connected motor-driven pump is attached to a leg of the machine directly under the water pan. The starting apparatus of this pump is also controlled by a push-button. The pressed-steel chucks with which the machine is equipped are intended for ring wheels 18 inches in diameter, with faces ranging from 1½ to 4½ inches in width, but 20-inch diameter disk wheels may also be used. The maximum distance between the ring wheels is 10 inches, and the height from the floor to the center of the spindles, 39 inches.

BATH MICROMETER INTERNAL THREAD GAGE

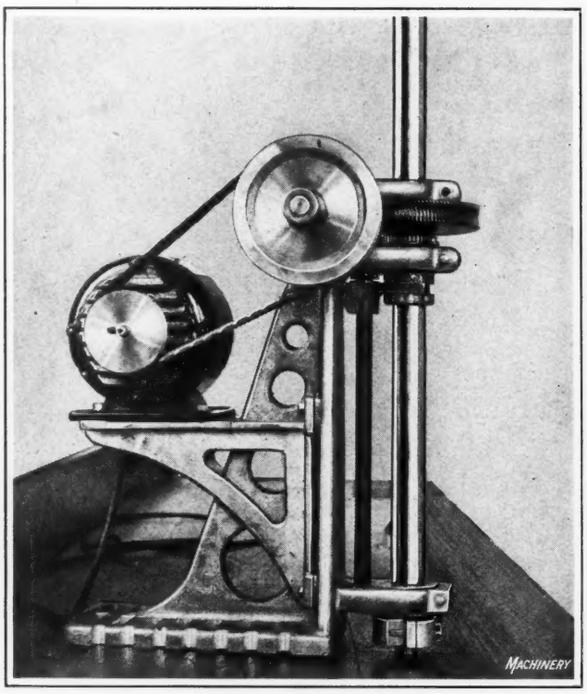
In April MACHINERY, a description was published of the micrometer plug gage then introduced by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. This concern has now developed the micrometer internal thread gage here illustrated, which contains the same features as the micrometer plug gage referred to, and enables the measurement of internally threaded parts to be readily accomplished in increments of 0.0001 inch; for instance, it enables the determination of the exact amount that a tap cuts over size. The four measuring jaws are held in alignment by closely fitting dovetailed slots in a slide which is operated by a micrometer screw. The moving parts are lapped and fitted so well, it is stated, that the gage is as rigid as a solid plug, and this rigidity causes different persons to obtain the same reading on a given piece.

Three distinct steps are taken in the manufacture of this gage to secure a measuring contact that will be as nearly perfect as possible. The jaws are first ground and lapped when set to the nominal size. They are again ground when set to the smallest size, and, finally, when set to the largest dimension. The subsequent grinding relieves the threads on each side of the center of the measuring jaws. In this way, the threads on the jaws are freed from interference due to the difference between the helix angles obtained at the largest and smallest settings of the gage.

When wear occurs on the measuring jaws, the gage may be referred to a master ring gage and the wear taken up by means of the graduated collar which is provided with serrations that enable adjustments of 0.0001 inch to be made. The gage enables studies to be made of the variations in the products of automatic screw machines, the action of taps when used with different cutting compounds, the effect of every thousand pieces on a tap in regard to wear, etc. The gage can be furnished with any number of threads per inch and in nominal sizes of from 1 to 5 inches in diameter.



Micrometer Internal Thread Gage, which is a Product of John Bath & Co., Inc.



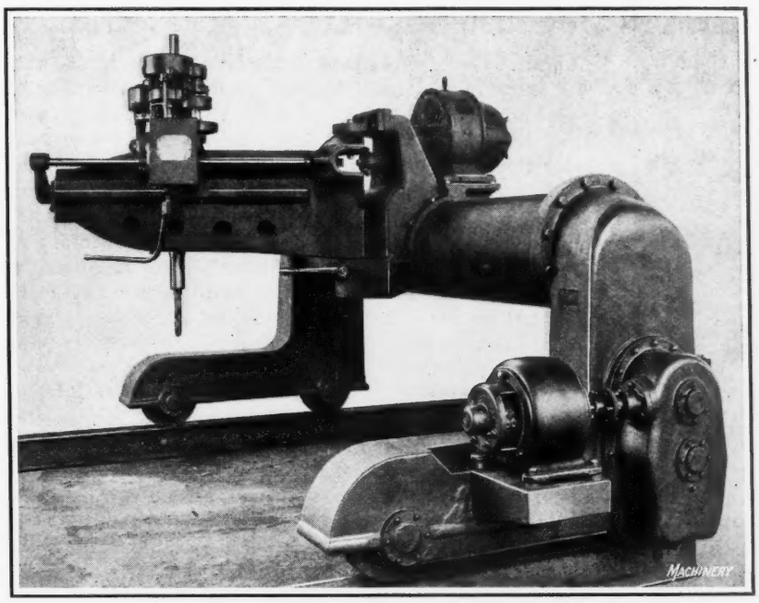
Keeler Automotive Cylinder Reboring Machine built by the Central City Machine & Tool Co.

KEELER CYLINDER REBORING MACHINE

To provide for reboring motor car engine cylinders without requiring the engine to be removed from the car, the Central City Machine & Tool Co., Syracuse, N. Y., has recently developed an equipment known as the Keeler auto reboring machine. It enables a garage man to do the entire job of reboring in his shop, and saves the time required to remove and reassemble the engine in the car. The machine is provided with three bronze bearings supporting a boring-bar. These bearings are split to take up wear and keep the machine in perfect alignment. The boring-bar is driven by a worm-gear that insures a uniform drive from the motor, which is of ¼ horsepower capacity and may be provided for alternating or direct current. Three cutter-heads are furnished for cylinders from 2¾ to 4½ inches bore, and they are constructed with a cam adjustment that gives a smooth equal movement. The four inserted cutters are placed opposite each other, and revolve on the boring-bar, which is accurately centered. This construction equalizes the pressure of the cutters during the entire operation. The cutters are made of "Rex AA" high-speed tool steel. This machine is the invention of L. S. Keeler of the Central City Machine & Tool Co.

STAMETS GANTRY TYPE OF DRILLING MACHINE

To meet the requirements of builders of tank, gondola, and other types of steel cars, as well as miscellaneous products where it is required to drill holes near the center of large steel plates, William K. Stamets, Jenkins Arcade Bldg., Pittsburg, Pa., has recently developed what is known as a gantry type of drilling machine, which is shown in the accompanying illustration. There is not a sufficient demand for drilling machines of this type, and the requirements which they must fulfill vary too widely to justify any manufacturer attempting to produce these gantry type machines as a standard product. The principle of design is one which lends itself especially well to the handling of those classes of work for which the present machine is intended, and it is the practice to build each machine to meet the special requirements of the shop in which it is to be used.



Gantry Type of Drilling Machine built by William K. Stamets

From the illustration it will be seen that this drilling machine is mounted on a track, the gage of which is wide enough to permit the drill to straddle the plates in which holes are to be drilled. Of course, the span of the drill and the gage and the length of the track can easily be adapted to the requirements of each user. Provision is made for traversing the drill on the track by means of a motor and adjustable controller. A drilling head is mounted on the radial arm which swings on its support on the cross-beam. Only one such radial arm and one drilling head are shown in the illustration, but two, three, or four arms and heads could just as readily be employed. Two arms can be used on each side of the beam, or if the span were increased, a larger number than four radial arms could be employed. More than one drilling head could be mounted on each radial arm if so desired. The motive power of the drill is supplied by a motor mounted on the beam, and with direct current an adjustable-speed motor can be used, while a multi-speed motor can be employed with an alternating current, permitting a wide range of speeds through the combination of electrically controlled changes with the mechanical changes of the drilling head.

IMPROVED PRATT & WHITNEY MEASURING MACHINE

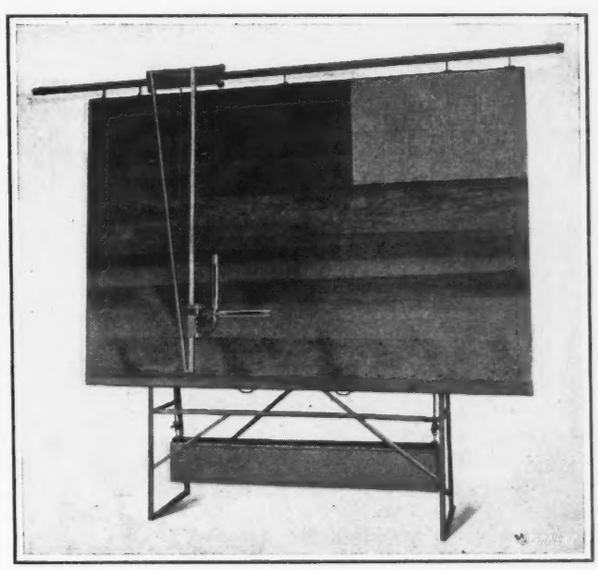
Several noteworthy improvements have recently been made in the design of precision measuring machines built by the Pratt & Whitney Co., Hartford, Conn. Pedestals can be supplied for the 36- and 48-inch sizes. These pedestals facilitate mounting, and in addition two brackets are furnished which support a wooden shelf mounted between the channels, thus affording a convenient place for holding work to be measured, etc. A tangent screw has been provided for the measuring head that facilitates making very fine adjustments of the index-circle. This was formerly accomplished by a knurled knob at the rear, but the tangent screw with its multiplied leverage supplies an easy movement, so that it will be easier to bring the anvil up to the measuring point without going by. A magnifying glass has been mounted over the index-circle, so that the measurement can be seen more accurately. When desired, a vernier may be added to the zero line for the index-circle, which will provide greater accuracy. The microscope on the objective tube has been improved, and a small electric light has been added at the bottom, to illuminate the cross-line of the microscope and the objective line which is etched on the plug of the standard bar.

SACREY OIL-GROOVING MACHINE

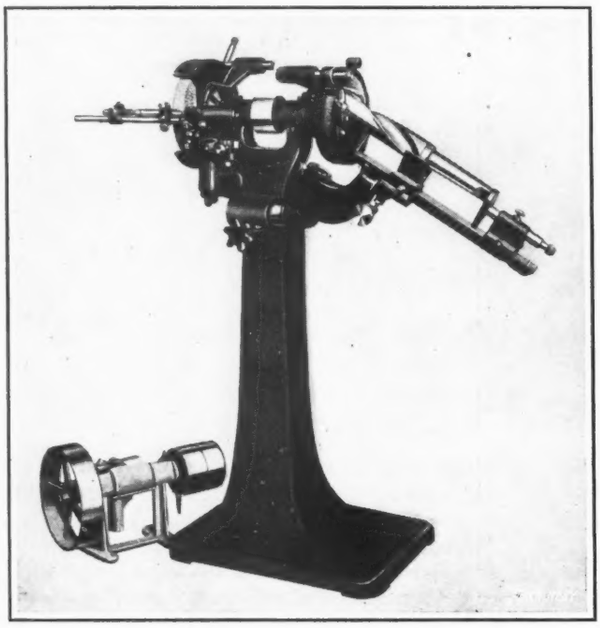
In January MACHINERY a description was published of the Sacrey oil-grooving machine which had recently been placed on the market by the Philadelphia Engineering & Machine Co., 1130 Race St., Philadelphia, Pa. Since developing the original machine, this firm has improved the design in the following respects. The feed mechanism has been simplified considerably. There is a long handle for manipulating the hand feed, and a short vertical button-shaft for manipulating the automatic feed. Another noteworthy improvement is the addition of a segment to provide for cutting double loops in a single operation. There is a lever at the base of the machine, which is a spindle-clamping lever that secures the spindle for cutting straight grooves or keyways, and eliminates any possibility of the spindle revolving. This machine may be driven by a belt from a tight and loose pulley, or it may be equipped with a direct-connected electric motor drive. When the latter arrangement is used, a ¾-horsepower motor and the gear and pinion for transmitting the power to the machine constitute a compact and effective drive.

SIMPLEX VERTICAL DRAWING-BOARD

The Simplex Tool & Instrument Co., 820 N. Third St., Camden, N. J., has recently added to its line of drafting outfits, the Style C movable vertical board shown herewith. This board is equipped with a Simplex drafting machine. It is regularly made 42 inches in width and to any length desired. The board is intended for use in making large drawings such as require a draftsman to be in a standing position while developing them. The board is counterweighted, and slides up and down on a pedestal, this being especially advantageous when a draftsman wishes to work at the top of a large drawing. The drafting machine is operated entirely by the left hand, thus leaving the draftsman's right hand free to use a pencil. The drawing-board may also be supplied with a frame to enable it to be attached to a wall, instead of being placed on the floor as shown in the illustration. This frame holds the board so rigidly that it does not vibrate when in use.



Vertical Drawing-board made by the Simplex Tool & Instrument Co.



Combination Tap and Drill Grinding Machine built by the Grand Rapids Grinding Machine Co.

GRAND RAPIDS TAP AND DRILL GRINDING MACHINES

Two styles of combination tap and drill grinding machines have been developed by the Grand Rapids Grinding Machine Co., 29 Ottawa Ave., Grand Rapids, Mich. The two sizes of the style illustrated are known as Nos. 10A and 10B. This machine is the same as the Style B2T which was described in MACHINERY for July, 1918, except that the plain tool-rest on that machine has been replaced by the tap grinding attachment. The two sizes of the second style of machine are known as 20B and 20C. On this style, the tap is held vertically and fed across the face of a cup-shaped wheel. These machines were designed to meet the requirements of shops in which the investment in two single-purpose machines would not be warranted.

Diamond truing devices are furnished for dressing the grinding wheels. In the case of Nos. 10A and 10B machines, two truing devices are furnished, one for the tap grinding wheel, and the other for the drill grinding wheel. Only one truing device, however, is supplied on Nos. 20B and 20C, as both the wheels on these machines are cup-shaped. The drill-holders on this line of machines are equipped with a safety stop which automatically places the drill-holder in the proper relationship with the face of the grinding wheel. The No. 10A machine has a capacity for drills from No. 52 to ¾ inch in diameter, and for taps from No. 6 to 1½ inches in diameter. The taper on taps is limited by the width of the grinding wheel, which is 1½ inches on regular equipment. The No. 10B machine has a capacity for drills from ⅛ to 1½ inches in diameter, the tap capacity being the same as on the 10A machine. The No. 20B machine is suitable for drills from ⅛ to 1½ inches in diameter, and for taps from ⅜ to 3 inches in diameter, while the No. 20C machine is suitable for drills from ¼ to 2½ inches in diameter, and for taps of the same sizes as the No. 20B machine. These machines are intended for operation at a spindle speed of 1600 revolutions per minute.

COLBURN RAILROAD BORING MILL

To meet the requirements of locomotive building and railroad shops in performing turning and boring operations on engine wheels, the Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio, and the Dale Machinery Co., 54-60 Lafayette St., New York City, and 541-547 W. Washington Blvd., Chicago, Ill., have recently cooperated in the development of a 90-inch machine, front and side views of which are shown in Figs. 1 and 2. The first six machines of this type were built on order for the American Locomotive Co.'s various plants in the United States, and this firm's standard specifications for a heavy-duty wheel boring and turning mill of the movable cross-rail type were adopted as a guide for the designers.

It will be apparent from the illustrations that, in general, the design of this boring mill follows established practice in the construction of machines of the movable cross-rail type. However, there are certain details to which the manufacturers call especial attention, and among these the following may be mentioned: Power is delivered to a single pulley from a 42½-horsepower 3 to 1 variable-speed motor which runs on 220-volt direct current. The driving pulley on the machine is 44 inches in diameter by 12 inches face width, and it carries a 10-inch belt. This pulley runs free on its shaft, connection to the gearing being accomplished by means of an Edgemont clutch, which is of the disk type and will transmit somewhat over 100 horsepower. The chief advantage of this arrangement is that the clutch is disengaged, and the brake applied with the same lever, making it unnecessary to overcome the momentum of the high-speed motor armature and the pulley and the belt. This allows the operator to stop the table instantly or move it around slightly when setting tools or work.

From the driving pulley, power is transmitted through gears which are enclosed in the bed of the machine and run in oil. Provision for efficient lubrication is one of the important features on a machine that is intended for heavy duty. Sight-feed lubricators are used to deliver a constant supply of oil to the spindle driving gears and feed-change gears. All gears are made of steel with cut teeth, so that

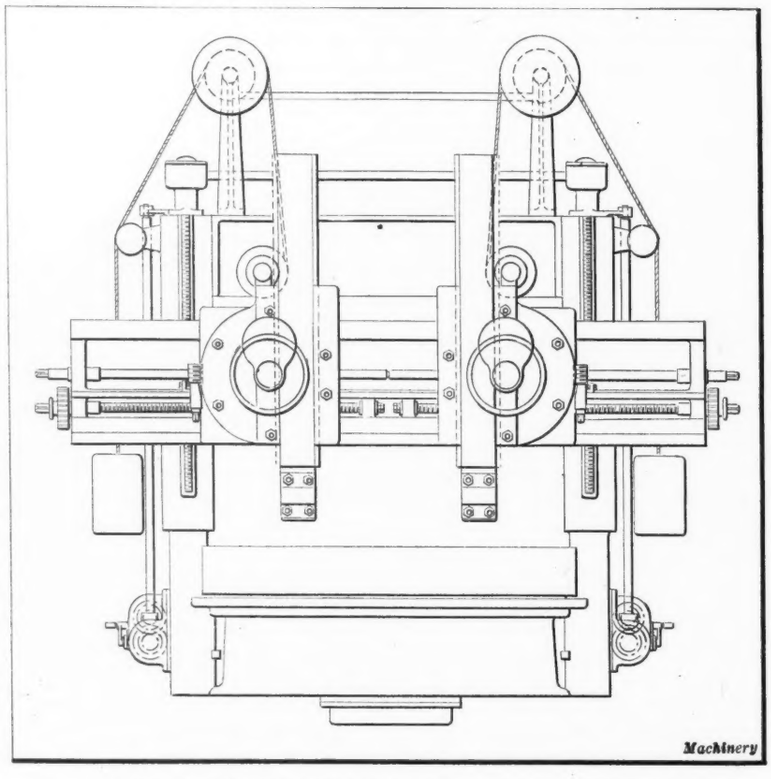


Fig. 1. Heavy-duty 90-inch Railroad Boring and Turning Mill built by the Colburn Machine Tool Co.

they possess ample strength and durability, and in this connection it is of interest to know that the full back-gear ratio is 104 to 1 with a maximum gear speed of only 1064 feet per minute. The table is driven by a pinion meshing with an internal gear which affords an advantageous condition of tooth contact.

The machine has demonstrated its capacity for taking a maximum cut of ½ by ⅛ inch in steel, with a cutting speed of 60 feet per minute. In working out the design, the fact has been constantly borne in mind that this machine is intended for severe service. For instance, the bed is of box form, reinforced with ribs and flanges. A cast-steel trough surrounds the bed to provide for catching cutting compound as it drips from the table. Large fitted bolts connect the bed and housings, which are also of box form and reinforced with ribs and flanges. The spindle is mounted on the table and has a suitable tapered bushing in the bed, which is provided with means of adjustment to compensate for wear. A powerful built-in independent four-jaw chuck is provided on the table; and in common with other gears in the drive, the table gear and pinion run in oil. All gears and other running members of the mechanism are effectively guarded.

A 5-horsepower independent motor provides for elevating and lowering the cross-rail, which is equipped with two independent saddles that are made right- and left-hand to adapt them for working close together. Either saddle may be moved to the center of the table for use in the performance of boring operations. All wear between the cross-rail and saddles, except on the face of the cross-rail, may be taken up with gibs made of cast iron. The cross-rail is of the narrow guide type. It is made of cast iron, and the saddles are made of steel. The rams are made of steel with cut rack teeth, and both swivels have adjustment up to 30 degrees on each side of the vertical position. Swiveling is accomplished by means of a worm and ratchet adjustment. Rapid hand movement is provided for the rams, and they are equipped with counterbalances that are arranged to exert a direct pull on the rams in any angular position. All feed gears are made of steel with cut teeth, and the feeds are reversible. Changes of feed are accomplished by sliding gears and clutches.

It will be of interest to mention a few of the important dimensions of this machine, which are as follows: Maximum swing, 91½ inches; maximum distance between table and cross-rail, 46 inches; spindle travel, 42 inches; diameter of table, 87 inches; diameter of track, 52 inches; width of track, 6 inches; diameter of spindle, 18 inches; length of spindle in bearing, 28 inches; table speed with back-gears in, 1½ to 4½ revolutions per minute; table speed with back-gears out, 6 to 18 revolutions per minute; number of available table speeds, 32; minimum vertical feed, 0.037 inch per table revolution; maximum vertical feed, 1⅛ inches; minimum horizontal feed, 0.022 inch; maximum horizontal feed, 0.672 inch; number of available vertical and horizontal reversible feeds, 8. The approximate weight of the machine, including the motor, is 67,000 pounds.

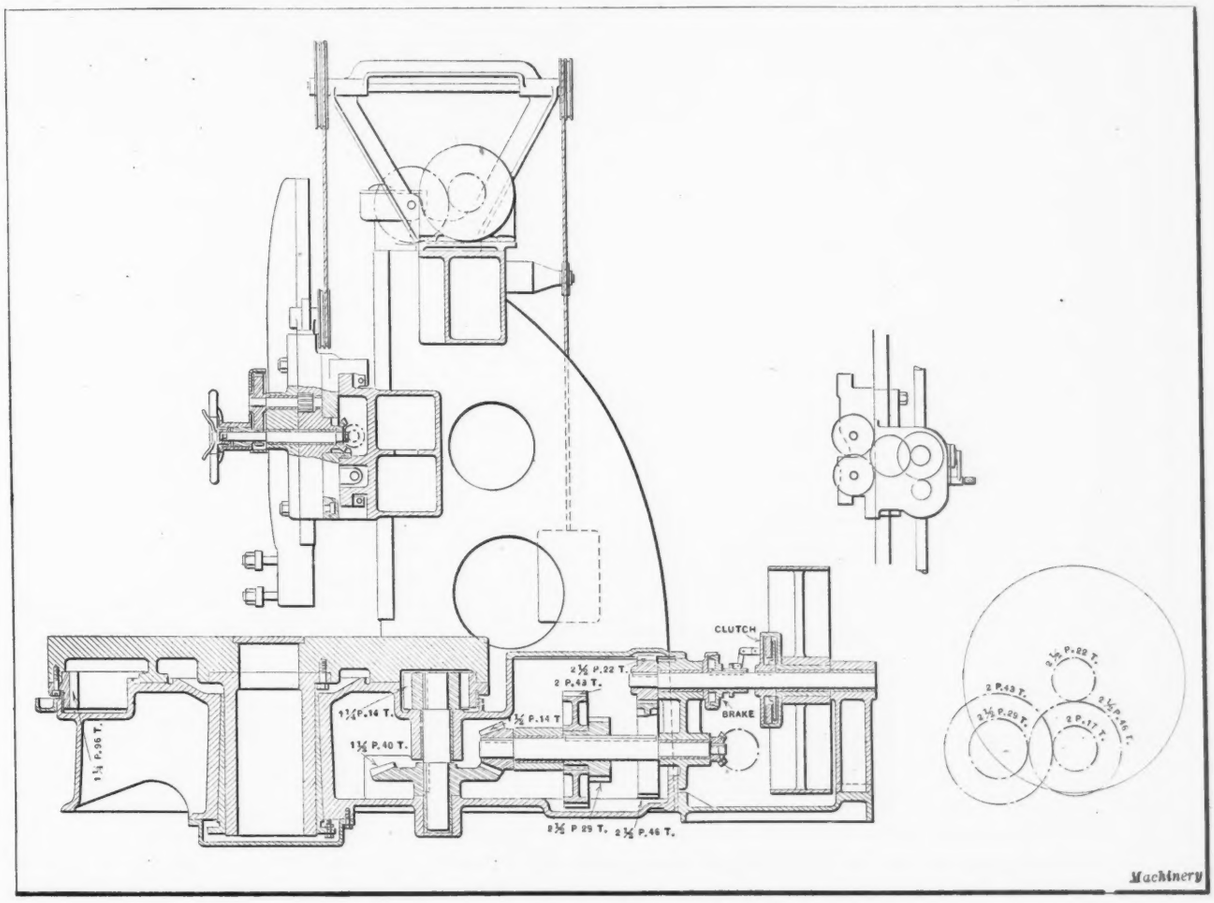


Fig. 2. Section through the Colburn Boring and Turning Mill shown in Fig. 1

JONES BORING, DRILLING, AND MILLING MACHINE

For use in handling such work as boring cylinders, motor housings, and other classes of horizontal boring mill work, the Jones Machine Tool Works, Philadelphia, Pa., has developed a horizontal boring, drilling, and milling machine of the planer-table type. The long table allows the operator to set up a similar piece of work while one is in the process of machining, and it also enables such work to be done as milling the faces of flange fittings and similar work that can be bolted down in a row on the table. This machine may

be driven by either a constant- or a variable-speed motor located at the base of the column. Power is transmitted to the vertical driving shaft through spur and bevel gears, and the vertical shaft drives through a set of heat-treated steel bevel gears and sliding speed-change gears to the bull gear and quill, and thence to the spindle. All of these gears are fully enclosed in the saddle which is shown in Fig. 2. The saddle is raised and lowered on the column by a bronze nut revolving on a steel screw, the movement being obtained by means of either the handwheel, power feed, or rapid traverse. Provision is made for traversing the main column on its base by hand, power feed, or rapid traverse, the movement being controlled from the saddle. Power for traversing the column is transmitted from the saddle gearing to a bronze nut and steel screw; operation by hand from the floor is also possible. A steel scale is set in the front vertical shear to facilitate setting the spindle in line with the outboard column bearing.

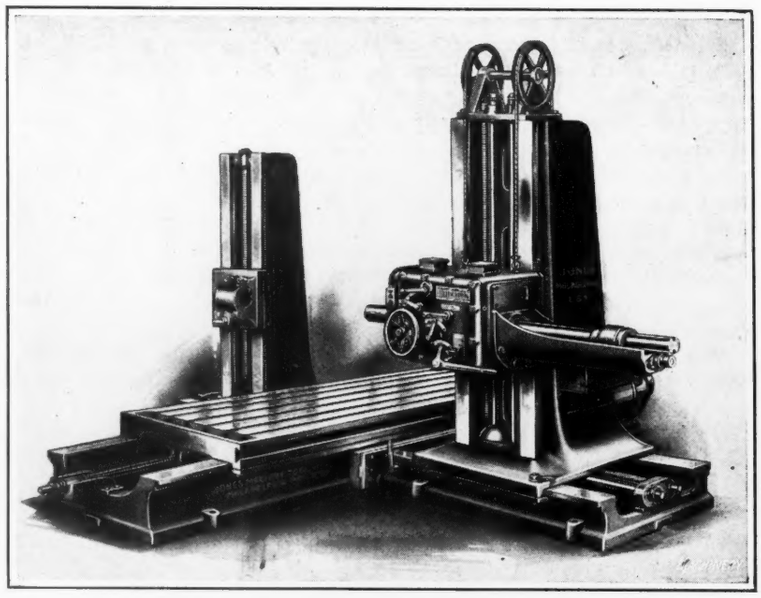


Fig. 1. Horizontal Boring, Drilling, and Milling Machine of the Planer-table Type, built by the Jones Machine Tool Works

The table is also operated from the saddle by hand, power feed, or rapid traverse, and there is also a hand feed from the floor. As in the case of the column movements, power is derived from the saddle gearing and transmitted to a revolving bronze nut and steel screw. There are T-slots in the top of the table for bolting down the work, and a dovetail is machined on the table face for use in holding down special index-plates and fixtures. The outboard column support is hand-operated for both horizontal traverse on the base and saddle traverse on the column, and there is a steel scale on the face of the shear for aligning the bearing with the spindle. A platform (not shown in the illustration) is slipped into position on the saddle when handling work that takes the operator from the floor. The central control on the saddle gives the operator complete control of the machine while on the platform, and this feature reduces the time required in the performance of the various jobs for which a machine of this type is adapted.

Fig. 2 shows the centralized control of the saddle. All levers are conveniently located and within easy reach of the operator. This illustration also shows the method of fastening on the faceplate, which may be furnished when required. All sliding speed-change and feed-gears, except the bull gear, which is made of electric steel, are produced from 0.60 to 0.70 per cent carbon steel and heat-treated. All gear shafts are made of steel and run in bronze bearings provided with sight-feed lubrication. The bull gear, in addition to being carried by a steel quill, runs in a large conical bearing that takes the thrust when using a faceplate, milling cutters or facing attachments. The quill runs in large bronze bearings located at each end of the saddle, and drives the spindle by two splined keys placed diametrically opposite each other. The front end is provided with a cone bearing adjustment to take up the wear of the spindle, and the rear end is arranged for a ball bearing thrust and adjusting nut.

The spindle is made from 0.60 to 0.70 per cent carbon steel and has a standard Morse taper bore at the front end. It is supported by the quill and a steel clamp bushing which runs in the bronze-bushed rear slide. Thrusts in either direction are taken by large bronze thrust washers located on the faces of the rear slide. The feed to the spindle is accomplished by a bronze nut in the rear slide, acting in conjunction with a steel screw. As in the case of other movements, it is operated by a handwheel, power feed, or rapid traverse. Power feed gears are all located in the front cover of the saddle, and are provided with a friction safety device. The rapid traverse is also of the friction type, and provides against breakages, should the spindle, saddle column, or table become jammed when at the end of one of their respective traverse movements.

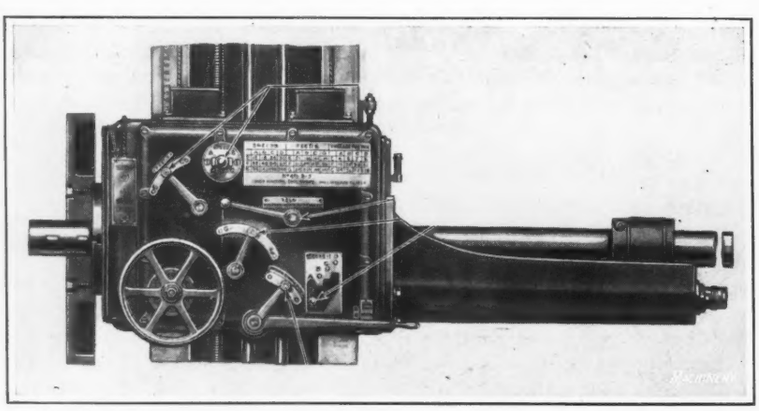


Fig. 2. Close-up View of the Saddle of the Machine shown in Fig. 1

BROWN & SHARPE MACHINISTS' TOOLS

The Brown & Sharpe Mfg. Co., Providence, R. I., has made additions to its line of machinists' and toolmakers' tools, and improvements to some of the older tools. One of the additions is the depth gage No. 607 shown in Fig. 1, which is furnished with three measuring rods. The micrometer screw has a movement of 1 inch, and by means of the rods, measurements ranging from 0 to 3 inches may be made. The gage handle is graduated in thousandths of an inch. Any measuring rod is easily placed in position by unscrewing the cap at the top of the gage, withdrawing the rod which happens to be in place, and then inserting the one to be used. When the cap is again screwed in place, the shoulder at the top end of the rod is brought against a finished seat. These shoulders on the rods are adjustable. The depth gage is obtainable with either a 2½- or 4-inch base.

The tempered hook rules Nos. 320 and 325 are now supplied with a hook that is reversible and has a shoulder which facilitates the setting of calipers and dividers. The

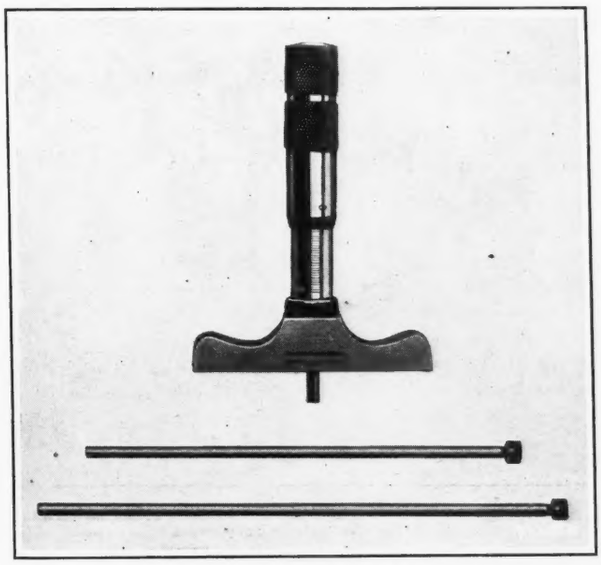


Fig. 1. New Design of Depth Gage made by the Brown & Sharpe Mfg. Co.

hook is held squarely and firmly on the rule by means of a screw, and while it cannot be pulled off unintentionally, it is easily removed to permit the rule to be used alone. An improvement has also been incorporated in the center heads furnished with combination squares and sets. Both arms of the center head are now ground to an equal length, so that their outer edges are equi-distant from the edge of the scale which runs through the middle of the center head. This improvement permits the employment of the center heads with work of large diameter, and thereby greatly increases their range.

The vernier calipers Nos. 570 and 571 and the 10-inch vernier height gage No. 585 are now made so that measurements can be read directly, without the necessity of making additions or deductions. Outside measurements are read

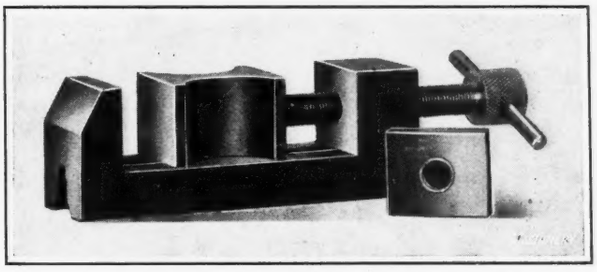


Fig. 2. Improved Design of Toolmakers' Vise made by the Brown & Sharpe Mfg. Co.

from a vernier on one side of the measuring bar, and inside measurements from a vernier on the other side. Points are placed on the bars and slides of the calipers for use in setting dividers, etc. A No. 644 thickness gage which has blades that are longer than on the regular line of thickness gages is now being made. It has nine blades, 3 inches long, ½ inch wide, and of the following thicknesses: 0.0015, 0.002, 0.003, 0.004, 0.006, 0.008, 0.010, 0.012, and 0.015 inch.

The toolmakers' vise No. 752 has been redesigned as shown in Fig. 2. This vise is handy in drilling, fitting, and laying out work on surface plates. It is casehardened and the base is ground. The steel movable jaw is provided with a tongue which slides in a slot in the base, the tongue being held in place by means of a strap. This feature prevents the jaw from lifting when work is being clamped. The strap can be removed to enable the jaw to be placed upside down on the base. When this has been done, tapered pieces can be clamped. The maximum distance between the jaws of the vise is 2 inches. There is a V-groove suitable for holding work ranging from 9/32 to 11/16 inch in diameter in the base, so that the tool can be used as a V-block. Each vise is provided with two movable jaws.

Another tool of interest is a No. 753 toolmakers' vise clamp, which is similar in appearance to the vise just described. However, it is not provided with the V-groove in the base, the tongue on the jaw, nor the corresponding slot in the base. These vise clamps are convenient for holding work to be drilled, and they are often used in pairs.

LANDIS CYLINDER GRINDING MACHINE

All makes and types of automobile cylinders that are cast en bloc, as well as a miscellaneous variety of irregular castings, may be ground on the No. 5 cylinder grinding machine shown in Fig. 1, which is a recent development of the Landis Tool Co., Waynesboro, Pa. The center of the grinding wheel spindle is located 10 inches above the top of the work-carriage, and so large castings may be handled without special fixtures. The grinding wheel spindle which is regularly

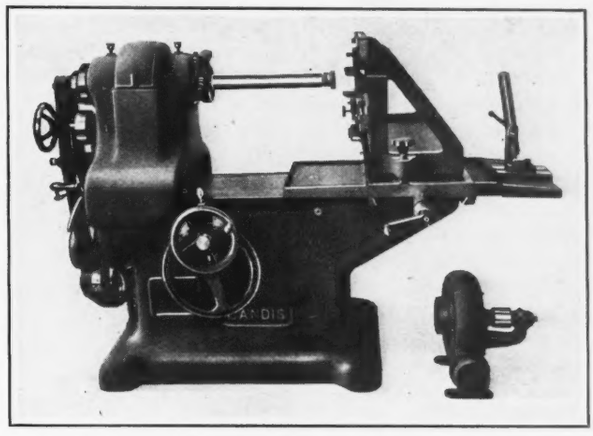


Fig. 1. Automobile Cylinder Grinding Machine developed by the Landis Tool Co.

furnished provides for the grinding of holes up to 15 inches in depth, and it is equipped with two wheels 2½ and 3½ inches in diameter, respectively. The spindle has an eccentric adjustment ranging from 1/16 to 1 1/16 inches, the adjustments allowing the grinding of holes as large as 5⅝ inches in diameter with a 3½-inch wheel. The eccentric adjustments are obtained by altering the relative positions of two eccentric sleeves, one of which is within the other. Extra wheel-spindles and sleeves may be furnished for grinding holes 20 and 22 inches deep or with diameters larger than 6 inches.

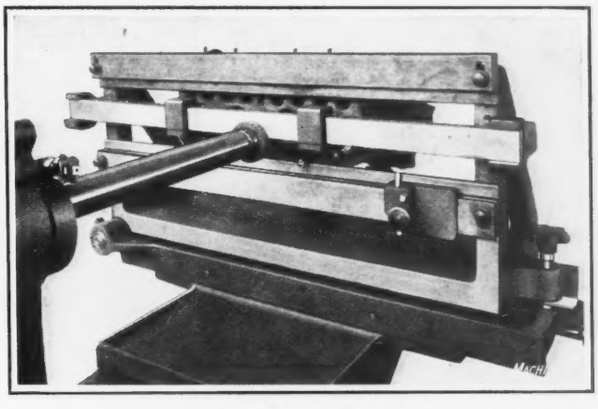


Fig. 2. Close-up View of the Work-carrying Fixture for the Machine shown in Fig. 1

The work-carrying fixture, shown in Fig. 2, is an angle-plate of an open design, which has two adjustable clamping bars to which the work is securely held by means of two heavy clamps. A feature of this fixture is the arrangement provided for quickly and accurately aligning the work in a vertical position in relation to the center. A bar having two adjustable centering brackets fits into two slots milled in the frame of the work-carrying fixture. Before clamping the work on the fixture, these centering brackets are inserted in the hole to be ground, in order to ascertain its exact size. They are then set to this dimension, and the centering bar is placed on the fixture. When the work is mounted on the fixture, it is placed over the two centering brackets, and thus accurately aligned. After the work has been clamped in position, the aligning bar is removed. A minor adjustment can be made by means of a screw, if the work has not been absolutely aligned by the means described.

Cross movements of the work-carrying fixture are obtained through the operation of a screw which is provided with a dial graduated in thousandths of an inch to facilitate accurate settings when changing from one cylinder to another. The work-carriage has a cross movement of 27½ inches, which is sufficient to enable the grinding of any motor block in one set-up. The work-carrying fixture is mounted on a carriage which operates on flat and dovetailed guides. These guides are lubricated by rollers running in pockets filled with oil. The longitudinal movement of the carriage is automatic, a reversing motion being obtained by the provision of two self-locking adjustable dogs. The carriage has a constant traverse of 10 inches per minute. The machine may be arranged for either a direct motor drive or to be driven from an overhead countershaft. With motor drives, a 3-horsepower motor, operating at 1150 revolutions per minute, furnishes ample power. The net weight of this machine is about 2900 pounds.

PRATT & WHITNEY "TRUS-FORM" SNAP GAGES

A line of what are known as "Trus-form" adjustable limit snap gages embodying several new features of design, has recently been added to the line of tools manufactured by the Pratt & Whitney Co., Hartford, Conn. These gages are constructed along the same general lines as a roof truss, with the metal placed where it affords maximum rigidity. This frame of triangular cells has the flanges and ribs in tension or compression, forming a light and stiff construction. The outer rib with its broken lines affords a sure grip for the fingers, even when they are oily. A unique adjustment is provided for the anvils as shown in Fig. 2.

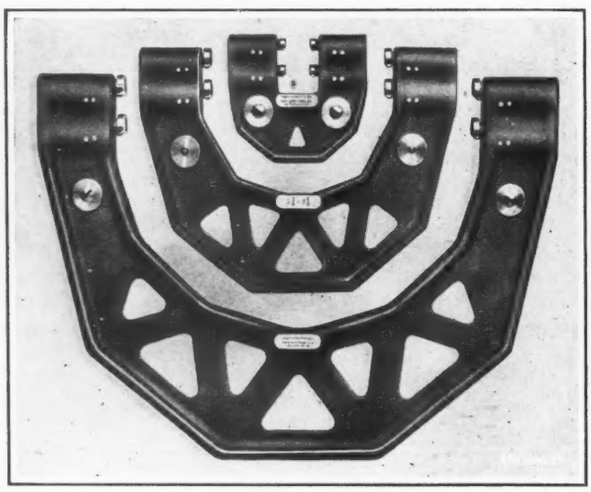


Fig. 1. "Trus-form" Adjustable Limit Snap Gages made by the Pratt & Whitney Co.

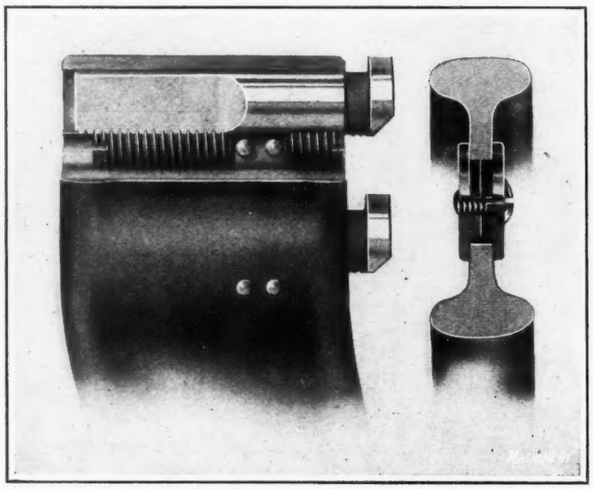


Fig. 2. Adjustment of the Anvils and Arrangement of Marking Plates on Pratt & Whitney Snap Gages

Two opposed screws pull in opposite directions like the screws of an independent lathe chuck, and by pulling one against the other the finest adjustment is easily made, this adjustment being positive in either direction. When both screws are tight, the anvil is securely locked against shake in any direction. It cannot be jarred loose and may readily be sealed. The holes in which the anvils work are accurately line-reamed, and the anvil faces are lapped square before assembling.

Except for the most exacting work, no lapping is necessary after assembling. New anvils may be substituted at any time, and they are strictly interchangeable. In sizes over ½ inch, all anvils have heads which permit of gaging to within 1/32 inch of a shoulder. In the smallest size, as an extra, two special anvils with offset heads may be used in the "Go" position, where it is necessary to work close to a shoulder. These are not needed in the "Not Go" positions. For marking sizes, tool numbers, operation numbers, etc., two pairs of brass buttons are secured by through screws in the manner shown in Fig. 2. They are readily removed to a bench plate for stamping, and they may be filed off and re-marked. One pair may be used for any permanent marking and secured by riveting over or soldering the point of the screw. Gages of this type are made to cover a range from 0 to 12 inches in fifteen different sizes, as follows: 0 to ½, ½ to 1, 1 to 1½, 1½ to 2, 2 to 2¾, 2¾ to 3½, 3½ to 4¼, 4¼ to 5, 5 to 6, 6 to 7, 7 to 8, 8 to 9, 9 to 10, 10 to 11, and 11 to 12 inches.

TWIST DRILL GRINDER

A twist drill grinding machine producing a ground drill point automatically and employing a different principle from that used in the past has been brought out by the Oliver Instrument Co., Adrian, Mich. This machine is of an entirely new design, and the point it produces is so shaped that, according to tests carefully made, drills ground on it will penetrate metal at a very rapid rate. The outstanding feature of the machine is the simplicity of operation and adjustment. All the operator has to do is to clamp the drill in the holder, and turn it to the correct grinding position, which is done by simply setting the lip horizontal, either by a gage on the machine or by the eye. After the drill has been clamped in the holder, the machine works automatically. It will grind two-, three-, and four-lipped drills with equal ease, simply by moving a handle to the proper position on a segment marked for the number of lips. No adjustment is required for different sizes of drills.

The drill to be ground is held by its shank in a spindle capable of rotating. The grinding wheel arbor revolves in ball bearings mounted in an oscillating cradle, which also

has an axial movement controlled by a cam in the body of the machine, these movements being so related that the wheel traverses the cutting lip of the drill until the point of the drill approaches the periphery of the wheel, the drill remaining stationary during this movement. When the drill approaches the periphery of the wheel it revolves automatically, the wheel moving forward. This motion has two effects; it increases the lip clearance toward the center of the drill, and it forms the clearance at the heel. It also cuts out the metal in the front of the chisel point where the drill lip usually drags, and produces a chisel point that is shorter, because of the angle at which it is ground.

The drill-holder consists of a rotating spindle provided with a taper hole to accommodate standard taper sleeves. The nose of the spindle is threaded to receive a chuck for holding straight-shank drills up to 1½ inches in diameter. The machine is so built that the spindle is permanently held at an angular position that will produce the proper point and clearance angles, the spindle being revolved by means of gearing. The drill to be ground is inserted in the spindle much in the same way as it would be inserted in a spindle for drilling, the only adjustment necessary being to set the lip horizontal as already mentioned.

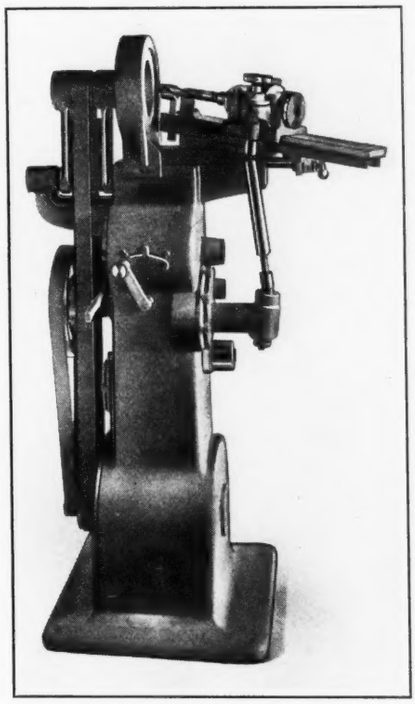


Fig. 1. Improved Type of Drill Grinding Machine built by the Oliver Instrument Co.

The operation of the machine is simple, because after the drill has been placed in the chuck and the lip set horizontal, the drill is simply brought into contact with the grinding wheel by turning the screw-feed back of the drill. The drill point is always in plain sight of the operator, so that he can see when the drill has been sufficiently sharpened. The motions of the machine are all obtained by mechanisms of simple design, with all gearing running in oil. A special mechanism is provided which automatically stops the machine in the proper position for setting the drill, so that the relative motions of the wheel and drill cannot change.

The machine is made either for belt drive or for individual motor drive. The countershaft and driving pulleys for belt drive are assembled in one unit and bolted to the pedestal, use being made of a foot-pedal belt-shifter. The speed of the countershaft is 1000 revolutions per minute. When individual motor drive is used, the motor is housed in a dustproof compartment in the base of the pedestal, the motor speed being 1750 revolutions per minute. The base of the pedestal is 20 by 20 inches, and the over-all length parallel to the slide is 32 inches. The height is 52 inches.

In order to prove that the drill point produced by this new type of twist drill grinder will penetrate metal at a very rapid rate, a simple testing device, as shown in Fig. 2, was made and applied to a drilling machine. As will be noted, the power required for feeding is obtained by weights attached to a rope wound about a circular segment which is mounted on the feed-spider of the machine. The edge of the segment is graduated so that it is possible to read off a given distance of penetration of the drill. By using a stop-watch and noting the time required for drills ground in different ways to penetrate a certain distance in the same piece of material, it has been found possible to test accurately the efficiency of the drill point that this new twist drill grinder produces.

In tests made it was shown that a 1-inch diameter new drill with the original grinding would require 1 minute and 48 seconds to penetrate a given distance, while when reground by the machine described, the same depth of hole was drilled in 1 minute and 18 seconds. In the case of a 1 1/16-inch drill, the respective figures were 1 minute and 45 seconds as compared with 1 minute and 17 seconds. Another new 1-inch drill required 1 minute and 29 seconds to penetrate to the same depth as the reground drill penetrated to in 51 seconds; and in another case a new ¾-inch drill required 1 minute and 7 seconds to penetrate the same distance as the reground drill penetrated in 53 seconds. It is interesting to note that the results obtained in the test made were not erratic, but quite uniform and consistent, the gain in penetrating rapidity obtained through regrinding the drill on the new twist drill grinding machine being a percentage not varying appreciably within certain given limits.

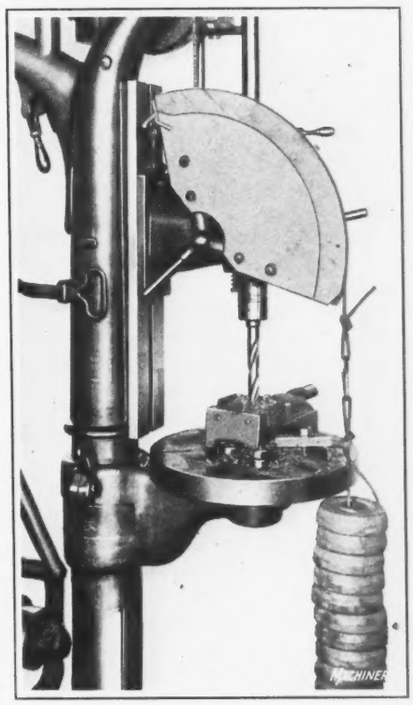


Fig. 2. Machine used for testing Drills ground on Machine shown in Fig. 1

The tests made indicate that the drill point permits of drilling more holes per hour than would otherwise be possible. As the point cuts more easily, it is also reasonable to assume that less power is required, and therefore drill breakages would be reduced. Another important point is that the operator requires no skill in producing the correct drill point, because the grinding machine performs its work independently of the operator after the drill is set with its lip horizontal.

HOUSTON, STANWOOD & GAMBLE LATHE

A newly designed heavy-duty triple-geared lathe of 60-inch swing has just been built by the Houston, Stanwood & Gamble Co., Cincinnati, Ohio. This machine is shown in the accompanying illustrations. The bed is a one-piece casting, 42 feet long, and the total weight of the lathe is approximately 40 tons. The machine is driven by a 35-horsepower variable-speed motor mounted on the headstock. An additional motor is furnished on the left end of the apron, affording rapid power traverse to the carriage. Two steady-rests are provided, the larger having a capacity for work from 23 to 37 inches in diameter, and the smaller, for work from 2 to 23 inches in diameter. The jaws of these steady-rests have bronze shoes.

The various spindle speeds are obtained by operating the levers and handwheel on the headstock, and the different positions of these are designated by letters to enable an operator to determine a speed readily by referring to this speed plate on the headstock casting. The majority of the headstock gears have a pressure angle of 20 degrees. Lubricant is delivered to the headstock by means of a pump mounted at the rear of the lathe, which is driven from the motor shaft. To insure that the oiling system is functioning properly, an indicator is located on an oil-feed line from the pump to the headstock. This indicator has an aluminum wheel which spins rapidly when oil is flowing. The wheel may be observed through a glass at the front of its container. A device is provided to prevent oil from flowing up on the motor pinion and leaking out through the housing. Fig. 2 shows a rear view of the gear-box located on the bed beneath the headstock, and gives an idea of its rigid construction.

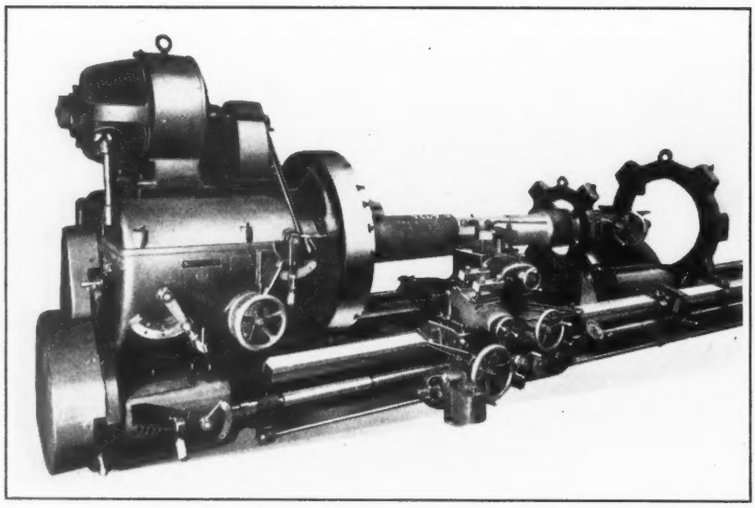


Fig. 1. Triple-geared 60-inch Lathe built by the Houston, Stanwood & Gamble Co.

Starting, stopping, and reversing of the motor on the headstock are controlled from a controller mounted on the right-hand end of the apron. The action is transmitted through the horizontal shaft near the bottom of the bed and through sprockets and a chain at the right-hand end of the bed, which connect with a second horizontal shaft at the rear. A long ratchet lever is provided at the left-hand end of the apron for exerting great pressure during a hand adjustment of the carriage, or for use in feeding the carriage along the bed under heavy cuts. A full-swing rest is mounted at the left-hand end of the carriage. Power traverse of the carriage is obtained by operating a lever on the apron, which engages a friction clutch. By moving this lever toward the operator, a positive clutch is engaged, which allows the carriage to be traversed by hand. The controller of the traversing motor is so constructed that the operator must hold the controller handle in position in order to run the motor. When the handle is released, it springs back to a neutral position. The friction clutch lever also springs to a neutral position when released.

A detailed view of the rear of the apron is shown in Fig. 3. There is an interlocking mechanism between the half-nuts for the feed-screw, the bevel gears, and the large outer bearing of the rack pinion. The rack pinion has stub teeth with a 20-degree pressure angle. The front and back walls of the apron are doweled and bolted together so that a practically solid box is obtained, which prevents the shifting of bearings out of alignment. The feed mechanism in the apron is driven through a positive angular-tooth clutch. This clutch permits feeds to be instantly engaged or disengaged without excessive strain on the operator's wrist. Both the front and back walls of the apron are bolted to the carriage.

At the right-hand end of the bed in Fig. 1, there will be noticed several supports for the lead-screw and control rod. One of the chief advantages of this type of support is that only a few seconds are required to remove a support and replace it at any position along the bed. Each support is furnished with bronze bearings for the lead-screw and control-rod, these bearings being accurately located on the hanger and fastened to it by means of a bolt. In a test on the lathe, a cut 1⅞ inches deep was taken on a 16-inch diameter, 0.50 per cent carbon, hammered steel forging, at a feed of ¼ inch per revolution and a speed of 15 feet per minute. The cross-sectional dimensions of the tool used were 2 by 3 inches, and its length, 20 inches.

PEARSON-SCOTT "IRON MAN"

The productivity of hand screw machines and turret lathes may be considerably increased by the application of an auxiliary mechanism known as the "Iron Man," which enables such machines to be made fully automatic in their operation. This device has been recently developed by the Pearson-Scott Co., 1523-1529 E. Washington St., Indianapolis, Ind., and is shown in Fig. 1 located at the right-hand end of a hand screw machine and connected to the various members, the operation of which it controls. Fig. 2 shows a close-up view of this device with the various covers removed, so that an idea of its construction may be obtained. This device does not interfere with hand operation of the machine, as it can be disconnected in a few minutes.

The mechanism consists essentially of a large disk with holes in it by means of which flat cams may be secured to it. These cams make contact with rollers mounted on cross-

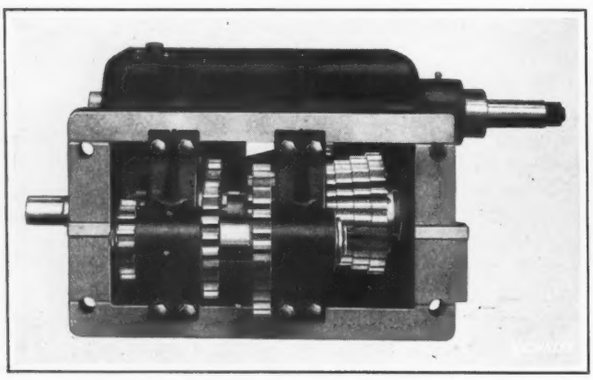


Fig. 2. Rear View of Gear-box on the 60-inch Lathe shown in Fig. 1

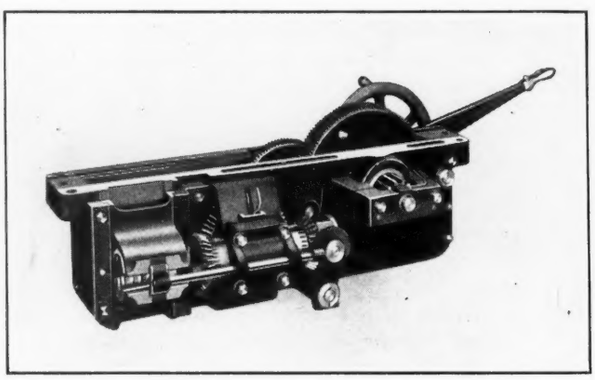


Fig. 3. Detail View of the Mechanism contained in the Lathe Apron

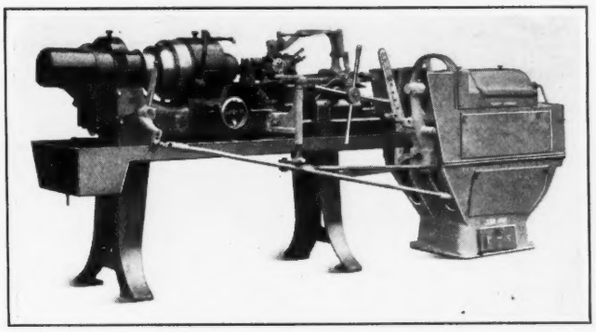


Fig. 1. Device built by the Pearson-Scott Co. for the Automatic Operation of Hand Screw Machines

heads that are attached to the ends of rods, the opposite ends of which are connected to the different units on the machine. The periphery of the disk has teeth in it which engage a worm mounted on a horizontal shaft. Thus, when this shaft is being driven, the disk is revolved. The cams are so placed on the disk that the various operations are performed in the proper sequence, one part being completed with each revolution of the disk. The locating of the cams on the disk is a simple matter, as the disk sides are stenciled with the shapes of the cams in the manner illustrated in Fig. 2, and the holes are drilled so that a cam will not fit in any other place except that in which it belongs. Twenty cams are supplied with each device, and this number is generally sufficient for one job. The indexing cams are never changed.

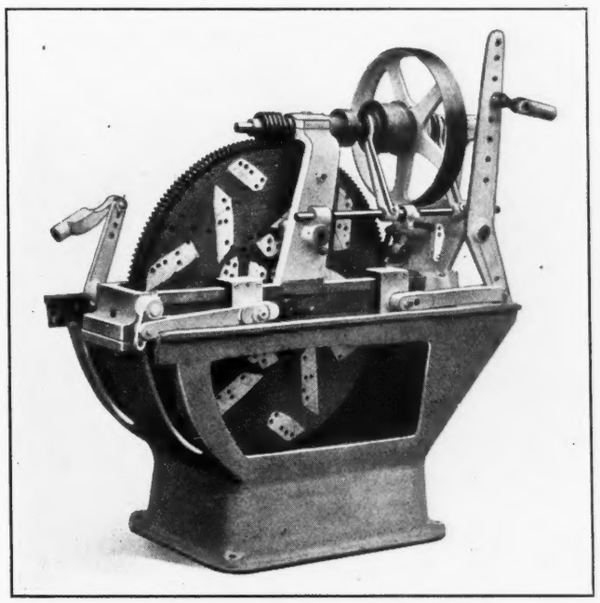
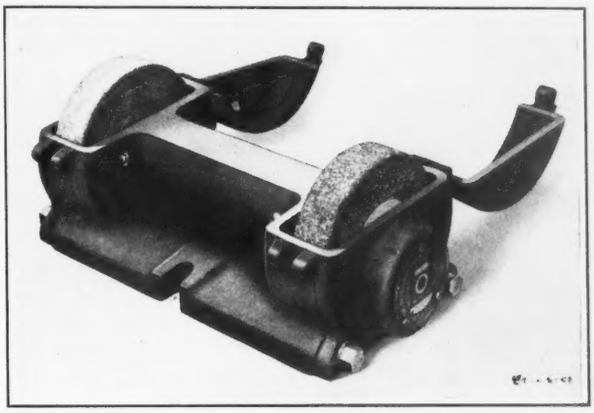


Fig. 2. Close-up View of the "Iron Man" with the Covers removed

The device may be located either at the right-hand end of the machine, as shown in Fig. 1, or at the left-hand end, and it may be used for driving simultaneously two machines doing the same kind of work. In case any of its members become clogged with dirt or chips so that they cannot function, or if the belt slips, damaging of the mechanism is avoided by the provision of a safety shearing pin. The countershaft supplied with the equipment is of a special design which will furnish the proper speed necessary for the material being worked, and which also regulates the feed. Automatic devices are provided for locking and unlocking the turret for indexing; setting dies for the cutting of threads; and controlling the feeding of stock. These units may also be supplied for attachment on hand-operated machines. The stock-feed control affords a stroke up to 12 inches. Attention is particularly called to the fact that the "Iron Man" does not necessitate the use of special left-hand tools. From two to six machines provided with this device may be tended by one operator.

PRECISION GRINDING-WHEEL TRUING MACHINE

The illustration shows a machine for truing grinding wheels of surface grinding machines, which is suitable for wheels up to 6 inches in diameter. This machine is a product of the Precision Truing Machine & Tool Co., Cincinnati, Ohio, and is known as the No. 23 truing machine. It is provided with two wheels which may be of different grades, so as to make it possible to use the machine for

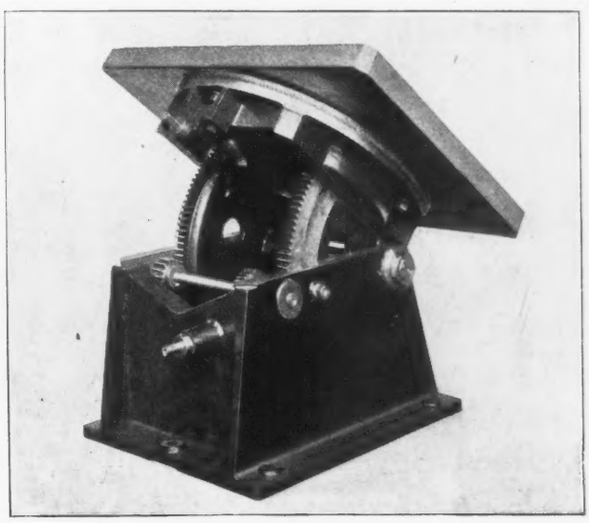


Duplex Grinding-wheel Truing Machine made by the Precision Truing Machine & Tool Co.

dressing grinding wheels on which different classes of finish are required; or one wheel may be used for roughing and the other for finishing a wheel. Hinged covers are provided to protect the wheels when they are not in use. The wheels are 4 inches in diameter, and have faces 1 inch in width.

PAWLING & HARNISCHFEGER TILTING AND ROTARY TABLE

As a means of speeding up work and reducing machine shop costs, a new work-table for use with floor type boring, drilling, and milling machines, which is known as a universal tilting and rotary table, has recently been put on the market by the Pawling & Harnischfeger Co., Milwaukee, Wis. This accessory makes it possible to carry on machining operations on five sides of a piece and at any angle,



Universal Tilting and Rotary Table for Use with Boring, Drilling, and Milling Machines, built by the Pawling & Harnischfeger Co.

with but one set-up. In the accompanying illustration the table is shown in one of its positions. It has an elevation of 90 degrees, and can be revolved a full 360 degrees at any position, whether flat or elevated.

There is a graduated dial conveniently placed to enable the operator to locate the work accurately. The table top is elevated by means of two coarse-pitch spur gear segments driven by means of a worm and pinions; and it is revolved independently by a bevel gear and pinion. One revolution of the ratchet handle revolves the table 30 degrees, and one revolution of the elevating handle elevates the top 2½ degrees. Adjustment along the bed plate parallel to the spindle travel is accomplished by means of a rack and pinion. The T-slots or table edges are used for locating the work, and the top of the table is provided with a trough to catch cutting compound.

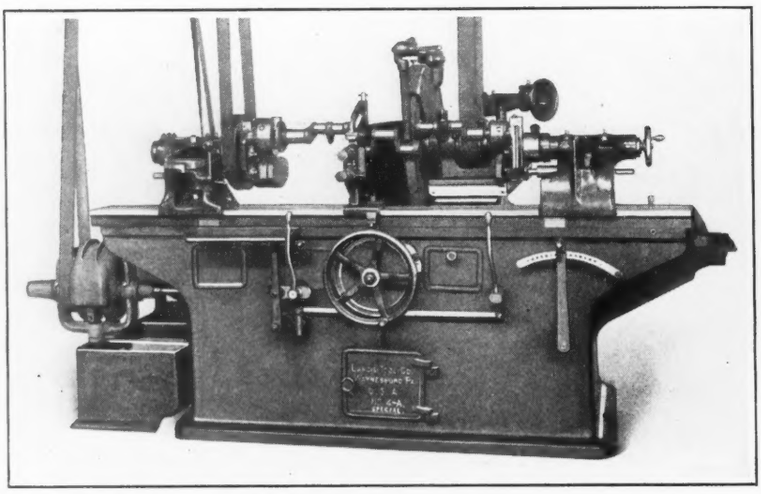


Fig. 1. Machine built by the Landis Tool Co. for grinding Automotive Engine Parts

LANDIS 4-A SPECIAL GRINDING MACHINE

A machine designed for grinding all parts of automotive engines, except cylinders cast en bloc, has been placed on the market by the Landis Tool Co., Waynesboro, Pa. This machine is known as the No. 4-A special, and is shown in Fig. 1. Particularly interesting features of this machine are the fixtures for supporting crankshafts while they are being ground. These fixtures are provided with balancing weights which can be moved in and out from the center of rotation to suit the throw of the crankshaft. The headstock fixture is illustrated in Fig. 2, and the tailstock in Fig. 3. Each fixture is equipped with a three-jaw universal chuck to grip the corresponding end of the crankshaft. The mechanism for locating the chucks to suit the different sizes of crankshaft throws is operated by a small crank. The member which this crank rotates is provided with an indexing dial.

The work-carrying fixtures are centered and brought into alignment through the use of locating pins. The crankshaft is then placed in the chucks and trued radially by the use of a truing device, after which the chuck jaws are drawn up fairly tight and the truing device removed, preparatory to the grinding operation. The regrinding of four-throw crankshafts is accomplished in from 1 to 1½ hours, while six-throw crankshafts are ground in from 1½ to 2 hours. Wheels 24 inches in diameter are used. The machine is driven by a 5-inch belt from a small countershaft, about 5 horsepower being required.

NIAGARA POWER SQUARING SHEAR

The No. 8-H power squaring shear illustrated has been added to the line of shears built by the Niagara Machine & Tool Works, 639-685 Northland Ave., Buffalo, N. Y. This machine is equipped with a set of gages that insures the accurate squaring of sheets, thus making possible their convenient handling and welding. The cross-head is of a heavy box construction, is guided in liberally proportioned ways, and is counterbalanced. The main shaft and eccentrics are forged in one piece of a tough grade of steel. The clutch block is equipped with removable hardened and ground striking jaws, as well as with hardened backlash jaws. The clutch wheel also has removable hardened and ground striking faces and a backlash pin. Two center bearings are supplied for the main shaft, and these are placed as close as possible to the eccentric and hold-down cams, so as to obtain the maximum support.

The hold-down cams bear against hardened steel rollers which are lubricated through hollow pins, and the hold-down rods are provided with springs to compensate for various thicknesses of plates. Self-adjusting brakes lined with asbestos are supplied, these brakes being made in hinged halves and equipped with automatic springs which compensate for wear. The knife chuck is provided with pockets that enable the knife bolts to be easily removed from the top. The chuck has T-slots on top to accommodate gages, and on the front for gage brackets. A screw and set-screw on each end of the knife chuck facilitate adjustments of this member. The housings are of massive construction and do not require stay-rods for cutting to the maximum capacity; however, stay-rods and stay-rod lugs

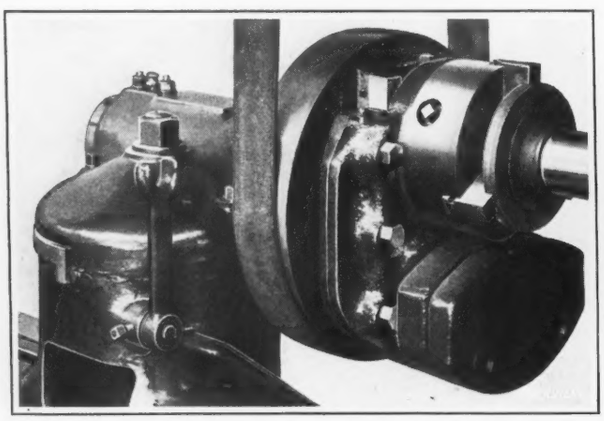


Fig. 2. Crankshaft Fixture on Headstock of Grinding Machine shown in Fig. 1

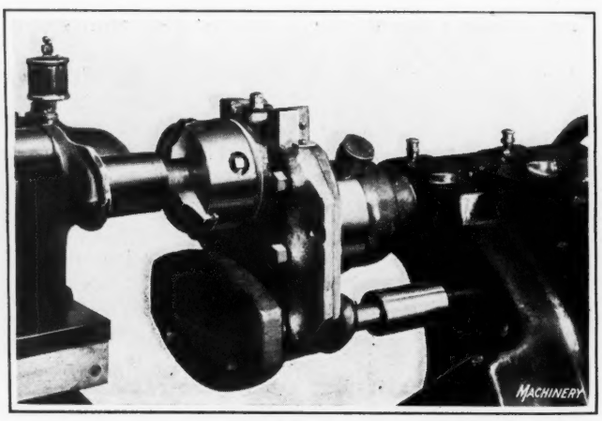
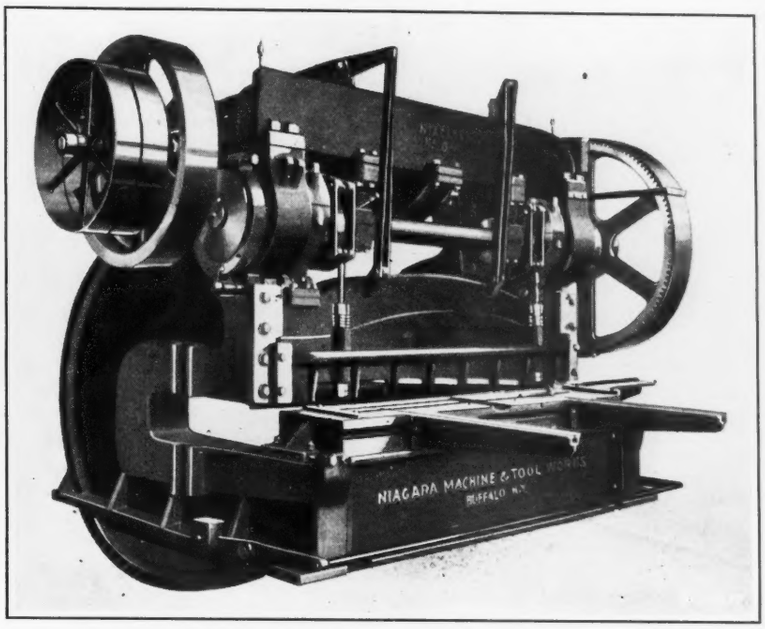


Fig. 3. Tailstock and Crankshaft Fixture on Grinding Machine shown in Fig. 1

are supplied if desired. The counterbalance rods are located outside of the housings, and so do not interfere with work being passed through the machine. The counterbalance weights are located below the floor line to comply with the safety codes of some states.

The gage equipment includes front, side, bevel, slitting, and patented automatic screw-adjusting back gages. The driving mechanism is placed overhead out of the way of the operator. The capacity of this machine is mild steel up to ⅝ inch in thickness; its nominal cutting length, 8 feet; the horsepower required for its operation, 30; the weight of a 24-inch gap machine, 27 tons; and the weight of a 36-inch gap machine, 30½ tons.



No. 8-H Power Squaring Shear built by the Niagara Machine & Tool Works

ANDERSON GEAR-CUTTER GRINDING MACHINE

To facilitate the grinding of tooth faces of small gear-cutters, such as are used on automatic gear-cutting machines employed in the manufacture of clocks, the Anderson Die Machine Co., Iranistan Ave. near Admiral St., Bridgeport, Conn., has brought out the machine shown in the accompanying illustrations. In Fig. 1, this machine is shown mounted on a base to which the driving motor and switch are also attached. However, it may be arranged for being driven by other means if desired. Referring to Fig. 2, it will be observed that the cutter to be ground is placed on spindle *A* which is mounted on bracket *B*. Located on this bracket there is also a finger *C*, which, by means of two adjusting screws, can be made to bear on the periphery of the gear-cutter close to the face to be ground.

On the lower end of spindle *A* there is mounted a worm-wheel which is rotated by a worm secured on the shaft to which handle *D* is attached. By rotating this handle, a tooth face can readily be positioned so that the proper amount of stock will be removed by the grinding wheel. Gage *E*, Fig. 1, is furnished to permit the location of the grinding wheel so that the tooth faces will always be ground radially with the center of the cutter. In using this gage, it is placed on bracket *B* with spindle *A* projecting through its hole, and then the wheel-head is adjusted until the edges of the wheel come in contact with two straight faces on the gage. After the grinding wheel has been located in this manner, the setting of the wheel-head is undisturbed, and the tooth faces are then ground by swinging the entire fixture on which the cutter is supported, around spindle *A*. A stop-screw is furnished to regulate the amount that a tooth face is to be ground.

A diamond truing device is furnished with the machine. This device is mounted on the cutter-spindle and is also operated to and from the wheel through turning handle *D*. When it is necessary to form the wheel, the diamond nib may be removed from the truing device and inserted in handle *F*. The spindle of the grinding wheel is hardened and ground and provided with ball bearings. A Webster Whitcomb watch-lathe collet chuck holds the grinding wheel.

LAWRENZ DRAFTING COMPASS

To facilitate the drawing of accurate circles E. Lawrenz, 2533 McClellan Ave., Detroit, Mich., has recently developed a compass known as the "Normal" for the reason that the pencil or pen point is held perpendicular to the plane of the paper. Since the scope of this instrument is for circles from 1/16 inch up to 12 inches in diameter, and with the extension bar up to 24 inches in diameter, it will be evident that sufficient range is provided to meet all average requirements. Two ruling pens are furnished in the same case with the compass and its auxiliary fittings. The features of these instruments are as follows: The center leg and the describing leg are always parallel, that is, normal to the plane of the paper, so that the centers about which the circles are described are not enlarged but remain small and accurately

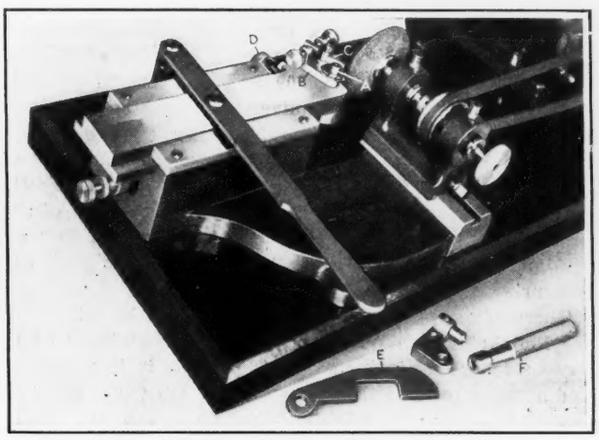


Fig. 1. Machine developed by the Anderson Die Machine Co. for grinding Small Gear-cutters

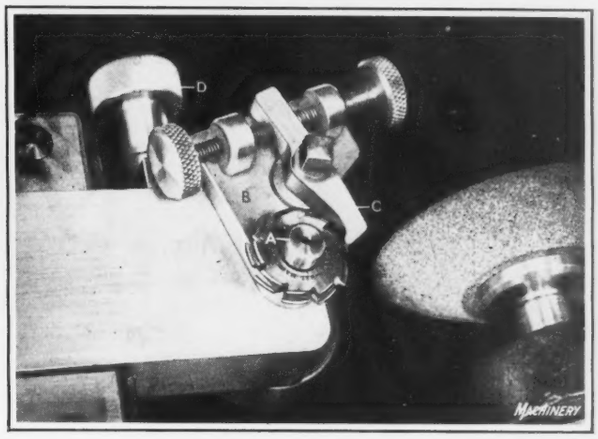


Fig. 2. Mechanism on Gear-cutter Grinding Machine, which locates the Tooth Faces to be ground radially

The "Normal" Drafting Compass recently developed by E. Lawrenz

placed, no matter how many circles may be drawn about the same center. The instrument may be quickly and easily set to any radius, and as readily clamped in that position, so that it is impossible for the compass to change its position.

There is no shake or backlash in any of the pivots about which different members turn, because they are of conical form, made of steel, and carefully hardened and ground. All of the adjusting screws are heat-treated and hardened, and the legs are rustproofed. There are two methods of rustproofing used for this purpose—one, the Parker process which leaves the arms jet black; and the other, electrosherardizing which leaves the arms gray, due to the coat of zinc which is amalgamated with the surface of steel..

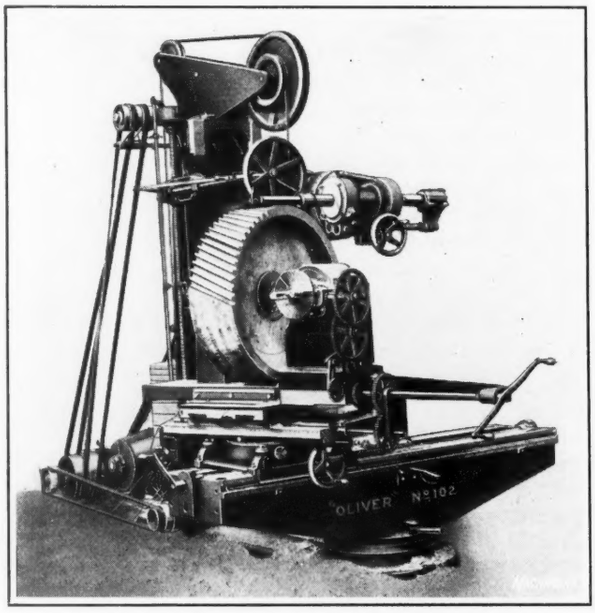
WAYNE DRILL CHUCK

For use in holding twist drills with broken shanks, the Wayne Tool Mfg. Co., Waynesboro, Pa., has recently developed the chuck which is shown in the accompanying illustration. The design is especially simple, the chuck consisting of only seven parts, namely, the shank, casing, two pawls, two screws, and a casing plate. The drill is ground to a 60-degree point at the broken end, which allows it to automatically center itself in a 60-degree recess in the shank; and upon turning the casing, the drill is locked in place by two pawls gripping it above the grooves. No wrench is required to tighten or release the chuck.

Chuck made by the Wayne Tool Mfg. Co. for holding Drills with Broken Shanks

ATTACHMENT FOR OLIVER PATTERN MILLING MACHINE

The Oliver Machinery Co., Grand Rapids, Mich., has produced an attachment for its No. 102 pattern milling machine, consisting of a complete set of appliances for cutting teeth on the patterns of spur, spiral, bevel, and worm gears. This outfit consists of a special 14-inch universal dividing head, tailstock, index-plate, index-chart, 6-inch faceplate, 12-inch faceplate, a set of raising blocks, change-gears, quadrants, and a mechanism for driving the dividing head. The attachment is so designed that in turning a pattern for a spiral gear, the pattern is rotated according to the angle of the spiral as the cutting tool progresses across the face of the pattern.



Cutting a Spiral Gear Pattern on a Machine built by the Oliver Machinery Co.

POLIAKOFF MACHINE-SHOP RULE

For the use of estimators, draftsmen, shop foremen, and machinists in solving a number of problems connected with the machining of bar work on a lathe or grinding machine, R. Poliakoff, 709 Sixth Ave., New York City, has recently developed a universal machine-shop rule, opposite sides of which are shown in Figs. 1 and 2. Its use enables problems to be solved without any calculations whatever. Reference to the illustrations will make it apparent that in addition to the special graduations provided for the solution of shop problems, one side of this rule is furnished with inch and millimeter graduations, so that it may also be used as a measuring rule.

There are six typical problems which can be solved with the Poliakoff rule. With the graduations furnished on the same side as the inch and metric scales, it is possible to find answers to the following problems: (1) Given the diameter of a bar or of a grinding wheel in inches, and the cutting or grinding speed in feet per minute; find the number of revolutions per minute of the bar when worked on a

Fig. 1. Universal Machine-shop Rule developed by R. Poliakoff for Use in solving Four Classes of Machine Shop Problems

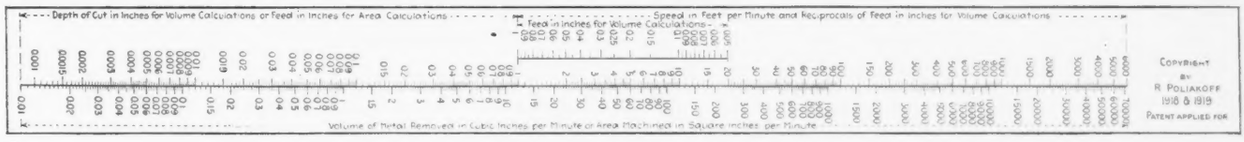

Depth of Cut in Inches for Volume Calculations or Feed in Inches for Area Calculations
Feed in Inches for Volume Calculations
Speed in Feet per Minute and Reciprocals of Feed in Inches for Volume Calculations
Volume of Metal Removed in Cubic Inches per Minute or Area Machined in Square Inches per Minute
COPYRIGHT BY R. POLIAKOFF 1918 & 1919 PATENT APPLIED FOR

Fig. 2. Opposite Side of the Poliakoff Machine-shop Rule, used for solving Two Classes of Problems

lathe or of an abrasive wheel used for grinding the work. (2) Given the diameter of a bar or grinding wheel in inches, and the number of revolutions per minute of the work or of the wheel; find the cutting or grinding speed in feet per minute. (3) Given the cutting or grinding speed in feet per minute, and the number of revolutions per minute of the work that is being turned or of the grinding wheel; find the diameter in inches that can be turned or the proper diameter of the wheel. (4) Given the length of a bar in inches, the feed in inches per revolution, and the number of revolutions per minute; find the time in minutes required to turn or grind the bar. Using graduations on the opposite side of the rule, shown in Fig. 2, the following problems can be solved: (5) Find the volume of metal removed in performing a machining operation. (6) Find the area of the work that has been machined.

In solving all of the six preceding problems, it is noteworthy that the graduations on the rule are used more as a chart than as a scale, that is to say, known values are located on the proper scales, and the results are read directly from the rule, without requiring any computations to be made.

NEW MACHINERY AND TOOLS NOTES

Expansion Reamer: New Britain Tool & Mfg. Co., New Britain, Conn. A six-blade expansion type of reamer adapted for use in garages and other shops. The ends of the blades are ground down to serve as a pilot. The range of sizes is from 15/32 inch to 4 1/16 inches.

Motor Drives for Hammers: C. C. Bradley & Son, Inc., Syracuse, N. Y. A line of motor drives adapted for use on the hammers of this company's manufacture. Motors for alternating or direct current and with various voltages, phases, and cycles can be furnished.

Metal-cutting Band Saw: Clark Machine Works, Belmont, N. Y. A metal-cutting band saw designed to meet the demand for a compact sprue-cutting saw for use in brass foundries and shops where brass, bronze, aluminum, or any of the softer metals are required to be cut.

Drill Chuck: Skinner Chuck Co., New Britain, Conn. A pinion geared three-jaw drill chuck having the gearing exposed, whereas other models of this company's manufacture have the gears enclosed. At present the chuck is made in one size having a capacity of 0 to 17/32 inch.

Aligning Reamer: Chadwick & Trefethen, Portsmouth, N. H. A new type of Critchley aligning reamer similar to the six-blade adjustable reamer of this company's manufacture. The reamer is supplied with an adjustable bushing that forms a pilot for accurately aligning the tool.

Power Hacksaw: Frontier Machine Tool Co., Inc., 122 Lakeview Ave., Buffalo, N. Y. A belt-driven power hacksaw provided with an automatic stop and a positive clutch in the driving mechanism. The normal speed is 65 strokes per minute, and the cutting capacity is 5½ by 6 inches, using blades from 8 to 14 inches in length.

Tool Grinder: Frontier Machine Tool Co., Inc., 122 Lakeview Ave., Buffalo, N. Y. A belt-driven wheel-stand type of grinder, which carries two wheels 15 inches apart. Guards and rests are provided for the two 12- by 2-inch wheels. The height to the center of the spindle is 39 inches and the weight without the countershaft is 195 pounds.

Coolant Pump: Alemite Die Casting & Mfg. Co., 2640 Belmont Ave., Chicago, Ill. A line of coolant pumps made in five sizes with capacities ranging from ½ to 10 gallons per minute when run at their rated speed of 300 revolutions per minute. These pumps have only four moving parts, the crank head, rotor, oscillator, and the extension.

Portable Pneumatic Grinder: Keller Pneumatic Tool Co., Grand Haven, Mich. A portable pneumatic grinder known as the No. 22-G, which is provided with a rotary-piston type of motor. The tool is built in two sizes, the smaller weighing 5¾ pounds, and the larger 18 pounds. The wheel is guarded and a well shaped grip is attached at the end of the motor housing.

Compressed Air Blower: New Jersey Meter Co., Plainfield, N. J. A small blower which transforms a small volume of high-pressure air into a large volume of low-pressure air for the operation of rivet forges and similar equipment. A comparatively small amount of air is utilized through the compressed air line, the greater portion of the air being drawn in from the outside.

Vertical Bulldozer: Beatty Machine & Mfg. Co., Hammond, Ind. A vertical bulldozer especially adapted for railroad steel car construction and repair work, being used for the pressing and forming of such parts as diaphragms, stakes, end sills, etc. It is built in sizes up to and including 500 tons ram pressure, with a distance between housings ranging from 8 to 12 feet.

Box-form Table for Planer: G. A. Gray Co., Cincinnati, Ohio. A box type of table for the planers of this company's manufacture, which has been designed especially to facilitate cleaning, and to give a greater degree of rigidity. The top and bottom surfaces of the table are firmly tied together by a heavy continuous wall of metal running the entire length of the table on its center line.

Industrial Truck: Baker R. & L. Co., Cleveland, Ohio. A new series C line of electrical industrial tractors and trucks replacing the series B formerly built. Special provision for taking the heavy thrust of the axle and the driving breaking strains is made to insure a higher degree of flexibility that will enable the truck to be used on smooth or rough road surfaces with a small expenditure of power.

File Handle: Parker Supply Co., 785 E. 135th St., New York City. A file handle known as the "Shur-grip," which is provided with a casehardened flexible steel thread in the file opening, into which the tang of the file is screwed. The thread is designed to cut into the tang of the file like a die and to hold the file rigidly. These holders are made in three sizes for use with files from 6 to 18 inches long.

Automatic Screw Machine: New Britain Machine Co., New Britain, Conn. A ⅝- by 3¾-inch six-spindle automatic screw machine which is similar in construction to the machines previously manufactured by this company. The machine carries six end-working and four side-working tools. The capacity of the chuck is ⅝ inch for round stock, 0.443 inch for square stock, and 0.542 inch for hexagon stock. The length of feed is 3¾ inches, and the length that can be milled is 3 inches.

Internal Grinding Attachment: Hjorth Lathe & Tool Co., 27 School St., Boston, Mass. An internal grinding attachment that can be used on practically any of the plain or universal grinding machines now on the market. The attachment is driven from a ceiling countershaft, and the spindles are of two types—one for deep and large holes, and one with tapered arbors for small holes; the latter accommodates small emery wheels and diamond grinding plugs.

Heat-treating Furnace: Bellis Heat-treating Co., Blake and Valley Sts., New Haven, Conn. A triple-unit furnace developed for the heat-treatment of high-speed steels. It is provided with burners in all three chambers, those in the outer chambers being used for bringing the furnace quickly to the working temperature. They are then shut off, and the relative heats maintained by the flame from the central chamber passing through flues. Either gas or oil burners may be furnished.

Air-operated Hoist: Denver Rock Drill Mfg. Co., 39th Ave. and Williams St., Denver, Col. An air-operated hoist known as the "Model 250 Waughoist." The cylinders of the air engine are enclosed in an oil- and air-tight case which protects the engine from the atmosphere and serves as an oil reservoir. The hoisting capacity is 500 to 1000 pounds at the rate of 68 to 143 feet per minute, depending upon the weight of the load. The drum holds 1000 feet of ¼-inch rope or 225 feet of ½-inch rope.

Shaping and Slotting Machine: Jones Machine Tool Works, Philadelphia, Pa. A vertical shaping and slotting machine made in two sizes with 6- or 10-inch stroke and equipped for either belt or motor drive. The 6-inch machine has three speed changes, while the 10-inch machine has four. The saddle, cross-slide and rotary tables are supplied with power feeds of the intermittent ratchet-feed type. The rotary table is graduated in degrees and has an indexing plate with spring stop for accurate spacing.

Burning-in and Running-in Machine: Phoenix Mfg. Co., Eau Claire, Wis. A machine designed to burn in and run in the main bearings on all makes of motor cars, trucks, and tractors. The burning-in operation is done at a speed of 200 revolutions per minute, and the running-in operation at a speed of 600 revolutions per minute. Ford and Fordson fixtures are regularly furnished, but other fixtures for different types of motors can be supplied. The machine weighs 2200 pounds, and occupies a floor space of 29 by 78 inches.

Cylinder Reboring Machine: Phoenix Mfg. Co., Eau Claire, Wis. A cylinder reboring machine designed for reboring motor cylinder blocks and which can be used either as a hand machine or with power. By the use of this machine, cylinders can be rebored without removing them from the chassis. Cylinders from 3⅜ to 4¼ inches in diameter can be bored with the cutter-head furnished with each machine, and cylinders up to 5 inches in diameter can be bored by using extra blades. The total weight of the machine is 160 pounds.

Quick-change Lathe: A. V. Carroll Machine Tool Co., Norwood, Cincinnati, Ohio. A 14-inch quick-change-gear lathe, the swing of which is 16½ inches over the bed, 19 inches over the gap, and 11 inches over the carriage. The head is equipped with either a three- or a four-step cone pulley or with either single or double back-gears as desired. Twenty-four changes of feed, either to the right or to the left, can be obtained by means of a conveniently located lever. The machine can be supplied with beds 6, 8, 10, or 12 feet in length.

Oil-grooving Machine: Fischer Machine Co., 310 N. 11th St., Philadelphia, Pa. An oil-grooving machine designed for cutting either straight or helical oil-grooves on the internal surfaces of bearings up to 15 inches in diameter and 15 inches in length. In appearance, this machine resembles an engine lathe, except that it is provided with a crank mechanism like that of a shaper, which imparts a reciprocating movement to the boring-bar in which the oil-grooving tool is held. In reality, the machine combines the standard features of an engine lathe and a crank shaper. Six spindle speeds ranging from 14 to 111 revolutions per minute are available. The swing over the bed is 19 inches, and the net weight of the machine is 3000 pounds.

* * *

BRIQUETTING PRESS FOR CAST-IRON CHIPS

A machine for forming the chips from turning, boring, and filing operations on cast-iron parts into briquettes, has been developed by the Danish Machine Co., Copenhagen, Denmark, and was described in a recent number of *Engineering*. It is claimed that in the production of ordinary iron castings, up to 15 per cent brisquettes can be made use of, and for special castings such as engine cylinders, the proportion can be further increased. The resulting iron is claimed to be compact and tough and to produce stronger castings than when pig and scrap iron are used alone. In addition, the briquettes provide a convenient means for introducing silicon or manganese into the metal. The press employed for this purpose can be used in a machine shop prior to sending the briquettes to a foundry, or the briquettes can be made in foundries from cast-iron chips purchased from a number of machine shops. The press has a vertical ram operated by a horizontal pneumatic cylinder through the medium of a toggle mechanism. The table of the press is provided with a mold attached to a pivoted arm, and the mold is filled with a mixture composed of chips, 5 per cent slaked lime and 5 per cent water. When filled on the side of the table, the mold is swung around under the ram for pressing, and afterward returned to its original position where a small auxiliary pneumatic cylinder is provided for the purpose of ejecting the finished briquette. The air pressure used is from 90 to 100 pounds per square inch.

The finished briquettes are in the form of truncated cones each weighing about 6½ pounds. After pressing, the briquettes are placed on drying trays, where they are allowed to remain for some days until they are sufficiently hard to be handled, when they are piled out-of-doors for from two to four weeks, according to the state of the weather until they are sufficiently hard for transportation to the cupola. When placed in the furnace they should first be covered with a layer of coke in order to prevent them from being crushed by the pig iron or large pieces of scrap. The melting of the briquettes takes place from the outside, and a thin skin, which forms over the surface, prevents the absorption of sulphur and other impurities. The percentages of manganese, phosphorus and sulphur are not altered during melting, but those of carbon and silicon are reduced rather rapidly. The variation of carbon within small limits, however, has no effect on ordinary mixtures of iron, and it need not be considered unless the proportion of briquettes in the charge exceeds 10 per cent. On the other hand, it is desirable to add a certain quantity of silicon to the chips used for making the briquettes. The wastage in melting amounts to about 20 per cent so that each briquette produces over 5 pounds of iron. An unskilled operator can produce from 120 to 150 briquettes per hour.

* * *

STAMPING FOREIGN MAIL

Time and again the Department of Commerce and the trade journals have pointed out the inconvenience to foreign correspondents of receiving mail from America with insufficient postage. Recently several correspondents in South America and Europe have written to MACHINERY complaining that American manufacturers do not stamp foreign mail with sufficient postage and that they have to pay double the missing postage abroad in order to receive their mail.

Every business house having foreign correspondence should inaugurate some system which will insure that the mail clerk will not overlook the proper stamping of foreign mail. Some firms have adopted the method of using different colored envelopes for domestic and foreign mail, so that the mail clerk automatically distinguishes the two kinds. In other instances, a rubber stamp is used, marking "foreign postage" in the corner where the stamp is affixed. Any method is good so long as it prevents sending mail abroad without sufficient postage, as this may prejudice the receiver against the firm sending the mail.

* * *

The next convention and exhibit of the American Foundrymen's Association will be held in the spring of 1922, in either April or May, instead of in the fall of the year as has been the custom for a number of years. The change was decided upon by the board of directors because of the difficulty of obtaining hotel accommodations and adequate exhibition facilities in the fall. The place, which will be selected by the convention and exhibits committee, and the exact date will be announced later.

* * *

Information has been received through the Department of Commerce that the Conference of American Chambers of Commerce in China, which was to have been held at Shanghai during the spring, has been postponed until September. It is hoped that all American Chambers of Commerce will send representatives, and where there are no American Chambers of Commerce, and where American interests are represented through other American associations, that these associations will name delegates qualified to participate in the activities of the conference.

HOLDING WORK ON THE VACUUM CHUCK

For holding pieces made of various magnetic and non-magnetic materials on grinding and milling machines, shapers, planers, lathes, etc., vacuum chucks sold by the Crescent Pump Co., Detroit, Mich., are used in essentially the same manner as magnetic chucks are employed for holding pieces made of iron or steel. The upper surface of a vacuum chuck consists of a flat plate perforated with small holes leading to an inside chamber which is coupled up to an exhaust tank. The high vacuum in this tank is maintained by means of a Crescent roto-piston vacuum pump, one of which can operate several chucks at the same time. Each chuck is supplied with a control valve, and as a result, the vacuum chuck is controlled by manipulating a valve in the same way as the magnetic chuck is operated by an electric switch.

From the preceding description, it will be apparent that both in shape and in its method of application, a vacuum chuck is quite similar to the type in which magnetism is employed as the holding force. A special point is made of the ability of the vacuum chuck to hold such non-magnetic materials as brass, bronze, fiber, glass, stellite, white metal, wood, rubber, etc. Iron and all kinds of steel can also be held equally well. It will be apparent that work can be carried by a chuck of this kind without marring a finished surface, and so it is the common practice where pieces are to be finished exactly parallel, to first accurately grind one side, and then chuck from this surface to provide for grinding the opposite side exactly parallel with the one previously ground. Thin pieces can be held without pulling them out of shape and without straining; and no trouble is experienced with this type of chuck from either the tools or the work becoming magnetized.

What is known as a "universal" top plate is ordinarily supplied with each chuck, but special plates can be made to meet the requirements of unusual classes of work. These top plates are easily removed, so that a chuck may be readily adapted for various jobs without serious loss of time. A gasket made of gum rubber, of varying thicknesses according to the roughness of the part to be held is used between the chuck and the work. In this gasket, holes are cut ¼ to ⅜ inch smaller than the size of the work. Each hole in the

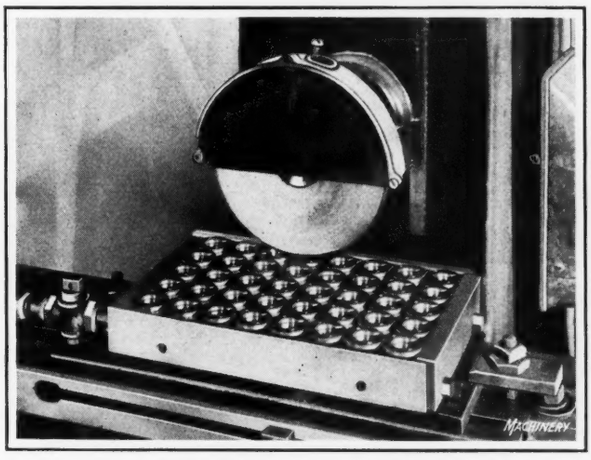


Fig. 1. Application of a Rectangular Vacuum Chuck in the Lincoln Motor Car Co.'s Plant, for holding Non-magnetic Bronze Washers while performing a Grinding Operation

rubber is placed over one or more holes in the chuck plate, so that when a piece of work is laid over the hole, the vacuum pulls it down firmly on the rubber, which prevents leakage of air between the work and the face of the chuck. A gasket of this kind is used for holding rough work only; for machining the second face, the work is held on its previously ground surface, and so a gasket made of paper should be used in place of the rubber one. Held in this manner, finishing cuts may be made within a limit of accuracy of 0.0002 inch.

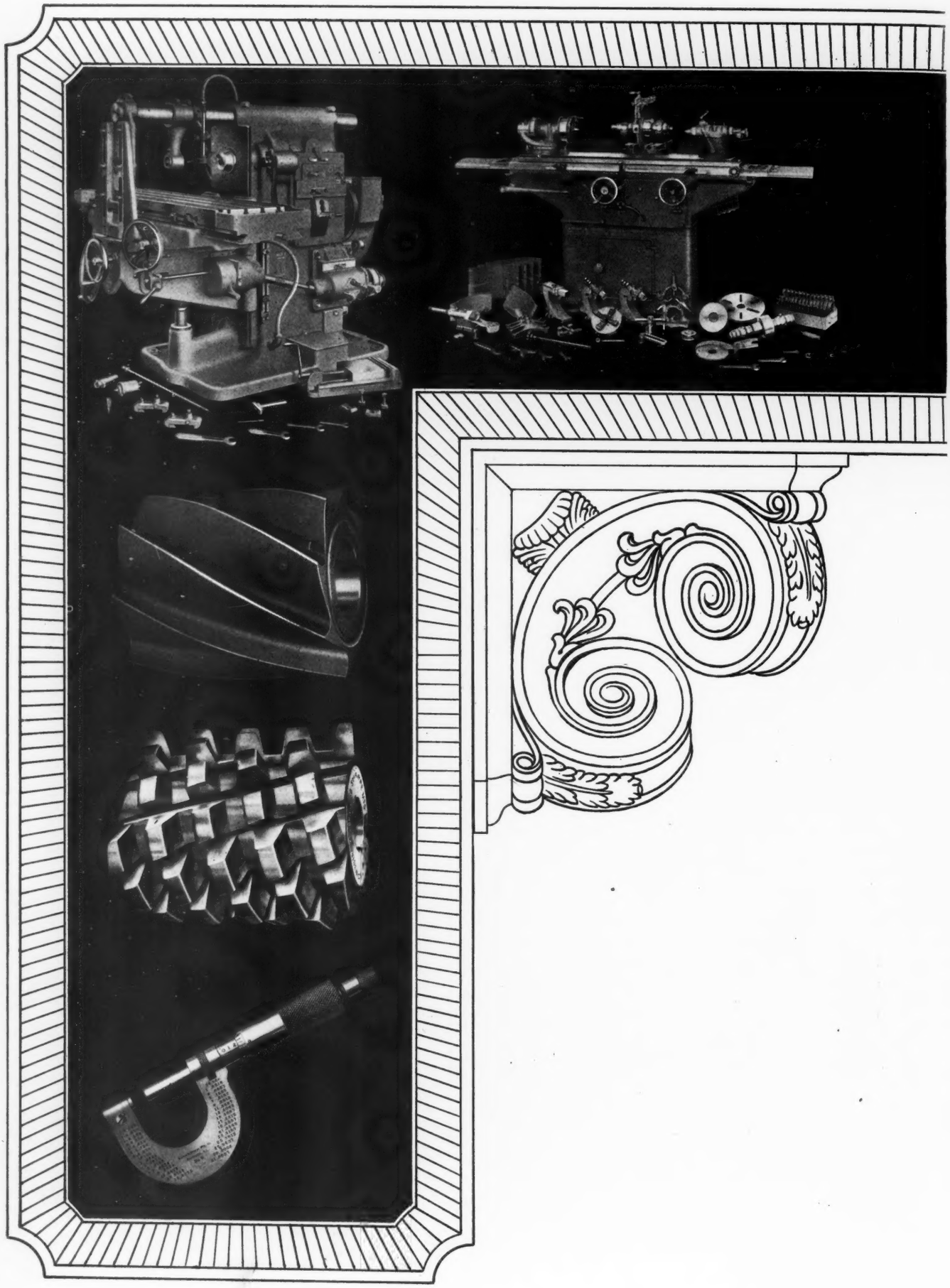
By making special chuck plates and cutting out the surface 1/32 inch deep over areas ¼ to ⅜ inch smaller than the pieces of work to be machined, the rubber gasket need not have large holes cut in it. Instead, it is laid over the face of the chuck and a hole is punched through the rubber or paper, corresponding in position to each small hole in the depressions on the surface. The depression 1/32 to 1/16 inch deep which is cut in the chuck face surrounding each hole affords sufficient clearance so that the air pressure above the work becomes effective in holding it firmly in place on the chuck. For machining the second face, no gasket is needed with routed out plates. When one of these chucks is used

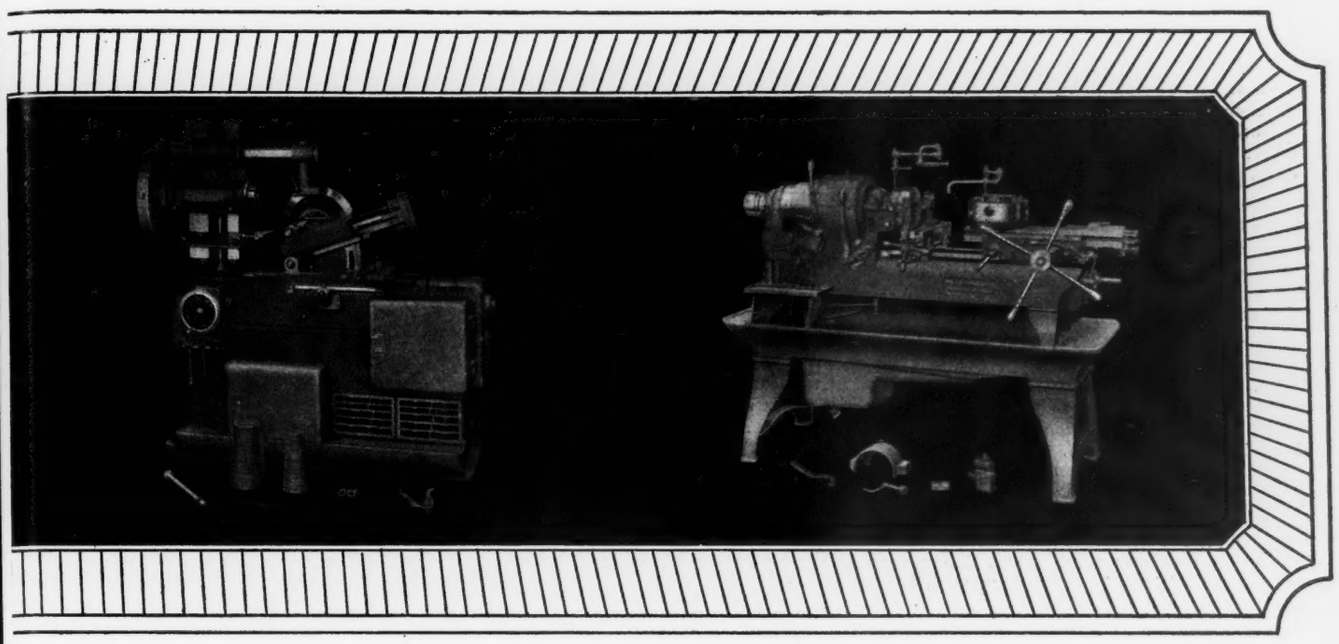
Fig. 2. Application of a Rotary Vacuum Chuck in the Haynes Stellite Co.'s Plant for holding Stellite Cutter Blades while performing a Grinding Operation

for taking heavy cuts, adjustable side plates are applied in the same manner as on magnetic chucks. Crescent vacuum chucks are made in 6- by 8-, 7- by 12-, and 7- by 18-inch rectangular sizes; and in addition, there is a rotary chuck measuring 16 inches in diameter. Special top plates are made for these chucks, to meet the requirements of the user. Special applications of this principle are made to suit all classes of work and machinery. In Fig. 1, one of the rectangular Crescent vacuum chucks is shown set up on a machine used for grinding bronze washers in the Lincoln Motor Car Co.'s plant in Detroit, Mich., and one of the rotary vacuum chucks is shown in Fig. 2 grinding stellite cutter blades in the Kokomo, Ind., plant of the Haynes Stellite Co.

* * *

The United States Civil Service Commission announces open competitive examinations for foreman mechanic in the air mail service. The applicant must have had either three years experience in the assembling, installation, testing, repairing, etc., of gasoline engines on automobiles, or have completed an apprenticeship or its equivalent as a machinist, and in addition must have had at least one year's experience in the installation, testing, and maintenance of airplane motors. Two years' experience in installation, testing, and maintenance of airplane motors will be considered a satisfactory equivalent of the above requirements; or one year's experience as rigger or repairman assigned to the building, maintenance, or repair of the structure of airplanes. Applicants should apply to the Civil Service Commission, Washington, D. C., for Form 1312, stating the title of the examination desired. Filled-in applications must be received by the Civil Service Commission not later than July 12.





B·S
TRADE MARK

WHETHER it's a Milling Machine, Grinding Machine, Gear Cutting Machine or Screw Machine, or whether it's one of the three thousand different cutters and hobs or 1,000 Machinists' Tools, if it's a Brown & Sharpe Product—it's built with skill and care, and pride in craftsmanship, and the High Standard of Brown & Sharpe Quality, known world-wide, stands out predominant.

Established 1833

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

PERSONALS

LIONEL A. WHARRAD, director and technical adviser of the British Needle Co., Ltd., Redditch, England, has recently come to the United States on a visit with a view to making business connections in this country.

P. R. LETTS has been appointed office manager of the industrial bearings division of the Hyatt Roller Bearing Co., New York City, to succeed G. J. Traendly, who is now office manager of the General Motors Corporation of New York.

CHARLES COPELAND, assistant treasurer of E. I. duPont de Nemours & Co., Wilmington, Del., has been elected a member of the board of directors and secretary of the company to fill the vacancies caused by the death of Alexis I. duPont.

ROBERT E. BELT, secretary-treasurer of the American Malleable Castings Association, Cleveland, Ohio, and Addison Boren, manager of the works accounting bureau of the Yale & Towne Mfg. Co., Stamford, Conn., have been appointed directors of the Industrial Cost Association.

H. N. WIETING, formerly with Berry Bros., has become associated with the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y. Mr. Wieting's headquarters will be in South Norwalk, Conn., his territory comprising the states of Connecticut and Massachusetts.

OSKAR KYLIN has recently been appointed general sales manager of the Foster Machine Co., Elkhart, Ind. Mr. Kylin has been chief engineer and a member of the executive board of the company for the last five years, and will still retain these positions in connection with his new duties.

RALPH S. COOPER, vice-president and general sales manager of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., who has just returned after spending eight months in Europe establishing branch offices and agencies for the company, has been appointed general manager. Mr. Cooper will fill this position in addition to his other duties.

J. O. G GIBBONS, formerly with Westinghouse, Church, Kerr & Co., and now engaged in private practice, has joined forces with C. E. BROWN, who for the last few years has been a United States ordnance engineer, forming a partnership as consulting engineers, under the name of Gibbons & Brown. The firm has offices in the Ordway Building, Newark, N. J., and is specializing in power plants and industrial problems.

NELSON A. GLADDING, vice-president and general manager of sales of E. C. Atkins & Co., Inc., Indianapolis, Ind., was elected president of the American Supply and Manufacturers Association at the annual meeting in Atlantic City on May 18. Mr. Gladding was previously president of the association in 1912-1913, and has served as a member of the advisory board of the American Hardware Manufacturers' Association, of which he was president in 1913-1914. Mr. Gladding has been connected with E. C. Atkins & Co., manufacturer of silver steel saws, for thirty-five years. He was manager of the Memphis branch of the company for twelve years, and since 1898 has had general charge of sales at Indianapolis.

* * *

OBITUARIES

J. FRANK BROWN, a member of the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y., died June 17. Mr. Brown had charge of the Pittsburg territory of the company.

R. E. LAMAR, of the sales organization of the Hilo Varnish Corporation, Brooklyn, N. Y., died June 6. Mr. Lamar had charge of the dealer trade in Philadelphia and adjacent towns.

WILLIAM A. KYTE, sales manager and member of the board of governors of the Foster Machine Co., Elkhart, Ind., died May 24 at his home in Elkhart. Mr. Kyte was born at Middlebury, Ind., on March 1, 1878, and his association with the Foster Machine Co. started in 1905. His death was due to heart trouble, following an illness dating from last January.

FRANK H. WHEELER, one of the pioneers in the development of the motor car industry, died at his home in Indianapolis on May 27. He had been in ill health and had been unable to take an active part in the business for some time. In 1902 Mr. Wheeler and Mr. George Schebler, inventor of the Schebler carburetor, organized the Wheeler-Schebler Carburetor Co. The original small shop developed into a plant employing a large force of skilled workmen. In addition to his connection with the Wheeler-Schebler Carburetor Co., Mr. Wheeler was president of the Langsencamp-Wheeler Brass Works and vice-president of the Stutz Fire Engine Co. of Indianapolis.

NEW BOOK ON USE OF CUTTING COMPOUNDS

CUTTING COMPOUNDS AND DISTRIBUTING SYSTEMS. By Edward K. Hammond. 119 pages, 6 by 9 inches; 44 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $1.

A study of current practice in the lubrication of metal-cutting tools shows that in many factories where the most modern methods of manufacturing are employed, little is known concerning approved methods of cooling metal-cutting tools by means of oils and compounds. This is doubtless due to the fact that it is difficult to place this subject upon a scientific basis, owing to the numerous variable factors involved.

The supplying of oils or compounds to the cutting tools of machines of different types and to plants differing in size and arrangement, requires a careful study of local conditions because different shops have different problems. The object of this treatise is to present definite useful information concerning the characteristics and uses of oils and compounds for various metal-cutting operations, specifications for the purchase of oils and compounds, methods of distributing, means for applying to the tools and work, methods of collecting after use, recovering oil from chips, filtering and sterilizing, and many other phases of this subject.

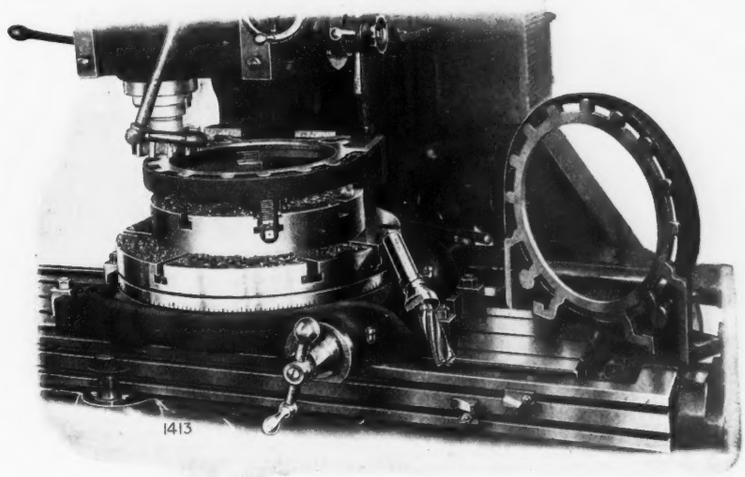
* * *

CENSUS OF THE MACHINE TOOL INDUSTRY

A preliminary statement of the general results of the 1920 census of manufacturers has been issued by the Bureau of the Census, Department of Commerce, furnishing statistics concerning the value of machine tools manufactured during the year 1919. Reports were received from 403 establishments engaged principally in the manufacture of this class of machinery. The products for the year were valued at $212,225,000. Of these establishments, 102 were located in Ohio, 46 in Massachusetts, 33 in Connecticut, 32 in Pennsylvania, 31 in Michigan, 29 in New York, 28 in Illinois, 24 in Wisconsin, 15 in Indiana, 14 in New Jersey, 13 in Rhode Island, 7 in Kentucky, 6 in Vermont, 5 each in Minnesota and Missouri, 3 each in Maine and New Hampshire, 2 in California, and 1 each in Delaware, Iowa, Kansas, Maryland, and Washington. The value of the different classes of machines was as follows:

Lathes:		
Engine	$22,630,000	
Turret	10,141,000	
Bench and other	4,094,000	
		$36,865,000
Milling machines:		
Plain	$ 6,470,000	
Universal	6,025,000	
Vertical	2,370,000	
Automatic	1,232,000	
Other	2,776,000	
		18,873,000
Grinding machines:		
Plain	$11,600,000	
Universal	2,066,000	
Other	1,725,000	
		15,391,000
Drilling machines:		
Radial	$ 5,702,000	
Multiple-spindle	1,999,000	
Sensitive	1,975,000	
Upright	1,754,000	
		11,430,000
Screw machines:		
Automatic	$ 7,076,000	
Hand	3,159,000	
		10,235,000
Boring machines:		
Horizontal	$ 4,438,000	
Vertical	4,330,000	
		8,768,000
Planers		8,129,000
Presses:		
Punching	$ 5,400,000	
Other	957,000	
		6,357,000
Gear-cutting machines		6,257,000
Hammers:		
Pneumatic	$ 3,070,000	
Other	1,882,000	
		4,952,000
Shapers		4,231,000
Pipe machines		3,178,000
Shears		1,566,000
Broaching machines		1,395,000
Bending machines		942,000
Portable tools		10,908,000
All other machine tools		26,075,000
All other products		36,673,000

Our Service Department replaced two boring mills with one No. 4 Vertical Cincinnati Miller and cut the time from 55 to 9½ minutes

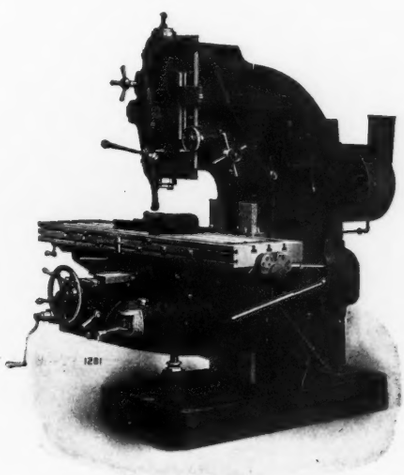


This is the end frame of an electric motor.

The large diameter is 20 in.

The diameter of the bore is 14½ in.

The rough casting is chucked on a 24-in. circular milling attachment.



This is the sequence of operations—

A 7½-in. face mill does the facing with one revolution of the attachment.

The work passes the cutter at the rate of 12½ in. per minute.

Our rapid traverse of 100 in. per minute clears the work from the cutter.

The quick change collet enables the operator to replace the face mill with an end mill in 30 seconds.

The knee is lowered until the end mill clears the work.

Note that in all adjustments the entire range of feeds is at the operator's finger tips and changes can be made in a second.

The work is carried to the cutting position at 100 inches per minute and stopped in place by an adjustable dog.

The end mill is lowered into the frame.

The frame passes the mill at 14¾ in. per minute.

The bore is finished with one revolution of the attachment.

The time from floor to floor is 9½ minutes.

Let our Service Department show you how to cut your production cost.

The Cincinnati Milling Machine Company

Cincinnati, Ohio, U. S. A.

COMING EVENTS

September 7-28—Shipping, Engineering and Machinery Exhibition, Olympia, London, W., England. General Manager, Frederic W. Bridges, 36-38 Whitefriars St., Fleet St., London, E.C.4.

September 14-16—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 34th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

October 3-4—Regional meeting of the American Society of Mechanical Engineers in Cleveland, Ohio.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

American Engineering Standards Committee, 29 W. 39th St., New York City. Annual report covering the activities of the committee for the year 1920.

School of Mines and Metallurgy of the University of Missouri, Rolla, Mo. Catalogue for 1920-1921, containing calendar, courses of study, and other related material.

University of Vermont, Burlington, Vt. Bulletin for 1920-1921, containing catalogue, announcements, courses of instruction, and general information.

Polytechnic Institute of Brooklyn, Livingston and Court Sts., Brooklyn, N. Y. Catalogue of the College of Engineering for 1921-1922 containing calendar, courses of study, and general information.

NEW BOOKS AND PAMPHLETS

Some Conditions Affecting the Usefulness of Iron Oxide for City Gas Purification. By William A. Dunkley. 62 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 119 of the Engineering Experiment Station.

The Functions of the Engineering Experiment Station of the University of Illinois. By Charles Russ Richards. 21 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill., as Circular No. 9.

Thermal Expansion of Copper and Some of its Important Industrial Alloys. By Peter Hidnert. 159 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 410 of the Bureau of Standards. Price, 25 cents.

Gasoline Automobiles. By James A. Moyer. 261 pages, 5 by 7½ inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $2.

The purpose of this book, as stated in the preface, is to present briefly and clearly the essential principles of automobile construction and operation, with the intention of furnishing practical help to drivers who desire to learn how to locate the cause of operating troubles and remedy them. The uses of the various parts of an automobile are explained, so that an operator will be able to anticipate repairs, and when repairs actually become necessary will know where to begin work. In dealing with carburetors and ignition devices, not all types are explained, but considerable space is devoted to an explanation of the principles underlying commonly used equipment and systems. A series of symbols has been adopted for the carburetor, which should make it easy to understand any type mentioned after a careful study of one type. The book contains ten chapters headed as follows: Automobile Types and Parts; Automobile Engines; Gasoline and Substitutes; Gasoline Carburetors; Automobile Ignition; Magnetos and Ignition Testing; Electric Starters; Clutches, Transmissions, and Differentials; Lubrication and Cooling Systems; and Automobile Troubles and Noises.

Patternmaking. By Edward M. McCracken and Charles H. Sampson. 111 pages, 11 by 8 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.

The purpose of the present book is to give students such a knowledge of the principles of patternmaking as will enable them to make any of the common types of patterns. The authors have made an effort to illustrate a definite principle in each pattern. The patterns selected are difficult enough to awaken interest on the part of the student, and yet are not so difficult as to cause the interest to be sacrificed merely to illustrate a point. Chapters are included covering the use of tools, information concerning woods of various kinds, and the principles of molding. The course is especially intended for use in technical, trade, and vocational schools who desire to present a practical course in patternmaking, the principal feature of the work being the large number of exercises for the student. The book is divided into two parts, the first section containing the text matter and general information, and the second part containing exercises for the student covering thirty different classes of patterns. In the text are discussed types of patterns; patternmaking methods; pattern details; hand tools; machines used by the patternmaker; molding; and foundry equipment.

NEW CATALOGUES AND CIRCULARS

Hauck Mfg. Co., 1718 Sansom St., Philadelphia, Pa. Bulletin 112 containing data relating to Hauck burners for foundries, and boiler, machine, and repair shops.

Warner Elevator Mfg. Co., Cincinnati, Ohio. Sheets for loose-leaf catalogue, illustrating push-button control apparatus for elevators, and Type EA direct-current controllers.

Foster-Johnson Reamer Co., Elkhart, Ind. Circular describing the features of construction of the Kylin adjustable general-purpose reamer. Price list and specifications are included.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Booklet illustrating and describing C-H magnetic clutches and their application. The illustrations show different types of installations of these clutches.

I. B. Williams & Sons, Dover, N. H. Catalogue of Williams belts, covering the line of flat and round belting, rawhide and tanned lace leather, Goodyear welting, and other products of this company.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has published its annual report for the year 1921, covering the gross earnings, manufacturing and selling costs, net income and other related data.

Griscom-Russell Co., 90 West St., New York City. Bulletin 1140, descriptive of the Stratton receiver-type steam separator, which is designed to remove water from steam by the utilization of centrifugal force.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Circular 36, illustrating and describing the "Thor" portable electric drill stand, for use with Nos. 000, 00, 0, 01, 1, and 2 "Thor" electric drills.

Larson Tool & Stamping Co., Attleboro, Mass. Circular illustrating Larson socket sets, single- and double-end spark plug sockets, triple socket wrenches, demountable rim braces, valve lifters, and valve grinding tools.

Oilgear Co., 60 Twenty-seventh St., Milwaukee, Wis. Bulletin 2, describing the Oilgear feed control system and its application to machine tools. This circular also contains dimension diagrams of Oilgear feed-control units.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin 6X, listing the features and uses of the P & H excavator crane No. 206, for handling machinery, excavating, dredging, digging foundations, etc.

Peter Gerlach Co., Cleveland, Ohio. Catalogue showing the line of machines built by this concern for the manufacture of barrels and kegs, which includes saws, jointers, stave planers, heading machines, dowel borers, rounders, presses, etc.

Condensite Co. of America, Bloomfield, N. J. Circular listing some of the advantages of "Condensite," a material which is applicable, in many cases, for parts where the design makes it impractical to use wood, metal, fiber, rubber, and other plastics.

J. E. Snyder & Son, Worcester, Mass. Catalogue illustrating and describing Snyder upright drilling machines, which are made in sizes ranging from 20 to 46 inches, and in belt- and motor-driven styles. A list of the repair parts for these machines is included.

Gifford-Wood Co., Hudson, N. Y. Pamphlet entitled "Mechanical Handling in all Lines of Industry," illustrating installations of elevating and conveying machinery of different types for all classes of mechanical handling in a wide variety of industries.

Griscom-Russell Co., 90 West St., New York City. Bulletin 330, covering Reilly evaporators for marine service. The bulletin contains a general description, tables of capacities, weights, size of connections, etc., as well as instructions for installing Reilly evaporators.

Bausch & Lomb Optical Co., Rochester, N. Y. Circular descriptive of parallel tube binocular microscopes, which, while permitting the simultaneous use of both eyes, still accommodates the single objectives ordinarily used on compound microscopes of the monocular type.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Catalogue entitled "The Cutler-Hammer System—Safest in the World," illustrating and describing the new line of control apparatus which has recently been developed by this company for use with high-speed newspaper presses.

John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. Bulletin 15, treating of the Bath "Easy-cut" ground taps. In addition to a description of the characteristics and construction of these taps, tables of sizes established by the National Screw Thread Commission are included.

Davis-Bournonville Co., Jersey City, N. J. Circular containing information relative to gas welding and cutting, acetylene generators, welding and cutting torches, and pressure regulators. The pamphlet is illustrated with views of Davis-Bournonville equipment, accompanied by specifications.

One Minute Valve Grinder Co., Ranier, Minn. Circular illustrating and describing the "One-minute" valve grinder with which it is claimed, a valve of ordinary size can be ground in from twenty to forty seconds actual grinding time. The grinder is crank driven, no air or electricity connections being required.

Wayne Tool Mfg. Co., Waynesboro, Pa. Catalogue 5, containing illustrations and tables of dimensions and prices of the line of taper bridge reamers made by this concern. The catalogue also shows the Wayne countersink, and the Wayne drill chuck designed for the purpose of salvaging broken twist drills.

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. Circular containing facts concerning the Jackson belt lacer, and describing the operation of lacing a belt with this type of machine. The machine is made in four sizes, namely, 6, 12, 18, and 24 inches, and will lace a belt 24 inches wide and ½ inch thick.

Terminal Engineering Co., Inc., 17 W. 44th St., New York City. Circular describing the features of construction of "Tec" motor-driven trucks, and their application for industrial haulage. The illustrations indicate the wide variety of uses for which these trucks are adapted by the utilization of different special bodies.

Hyatt Roller Bearing Co., 709 Sixth Ave., at 41st St., New York City. Circular treating of the application and methods of installation of Hyatt roller bearings for all kinds of trucks. The illustrations show a large number of trucks equipped with these bearings. Copies of the bulletin will be sent without cost upon request.

Consolidated Tool Works, Inc., 296 Broadway, New York City. Catalogue B, containing data on the line of tools produced by this company, which includes hacksaw frames, smooth and jack planes, hand drills, breast drills, calipers and dividers, tap wrenches, and micrometers. Copies will be sent to those interested upon request.

Barnhart Bros. & Spindler, Monroe and Throop Sts., Chicago, Ill. Circular containing information relating to "Tenso" die-castings, including physical properties, comparison of lightness and hardness with other metals, and other characteristics. The circular shows a large number of parts which have been made from "Tenso" die-castings.

J. M. Ney Co., Hartford, Conn. Circular illustrating and describing the Ney "positive-grip" collet chuck, which represents a combination of the principles embodied in the usual three-jaw chuck, drill chuck, and draw-in collet type. The chuck is adapted for use on lathes of the standard or turret type, screw machines, and milling machines.

Manufacturing Equipment & Engineering Co., 136 Federal St., Boston, Mass. Circulars illustrating "Economizer" fountains and other types of drinking fountains for factory use; metal sanitary and fireproof shop equipment, including lockers, chairs, tables, stock racks, etc.; group wash-bowls and metal storage cabinets; and price list covering the foregoing equipment.

Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J. Catalogue treating of electric arc cutting and welding by alternating current, describing in detail the "Alternarc" portable welding and cutting machines, electrodes, supplies, and accessories. The application of the electric arc welding process for different classes of work is illustrated and described.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio. Catalogue 47, covering the standard line of hydraulic wheel presses made by this company. A general description is followed by illustrations and specifications for the different types of presses, which are made in vertical and inclined styles, with pressure capacities of from 50 to 600 tons. Copies of this catalogue will be sent free upon request.

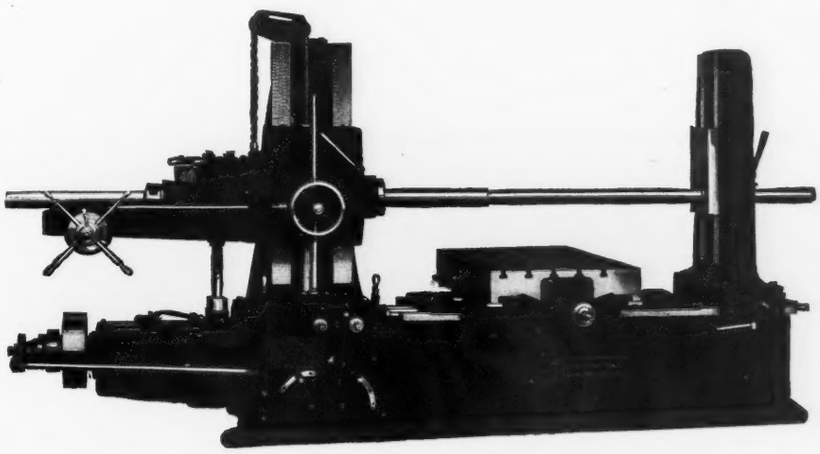
Truscon Laboratories, Detroit, Mich. Technical Pamphlet No. 8, treating of the subject of waterproofing concrete. In addition to a discussion of why concrete requires waterproofing, and the properties the integral waterproofing must possess to operate effectively with concrete, the pamphlet contains specifications for waterproofing concrete. This booklet is distributed free to any engineer, architect, or builder upon request.

New Departure Mfg. Co., Bristol, Conn., announces that it is resuming the publication of the New Departure ball bearing engineering data sheets. The first of these bulletins, No. 129, contains calculations of bearing loads due to gears, covering the loads resulting from the five most commonly used types of gears—the straight spur gear, the helical spur gear, the straight bevel gear, the worm gear, and the spiral bevel gear.

"The nicest thing about PRAISE is that you have to
LIVE UP TO IT"
Therefore, every NEW user of the

"PRECISION"

Boring, Drilling and MILLING MACHINE



gets the benefit of the "other fellows" praise (and there are very many of the "other fellows".)

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

Peerless Machine Co., 1611 Racine St., Racine, Wis. Circular describing the operation and construction of the Peerless high-speed sample-section tire cutter, for cutting accurate sample sections from regular stock tires or straight molds. Circular of the Peerless high-speed rubber cutter, containing a partial list of users and letters of recommendation. Circular descriptive of Peerless high-speed heavy-duty metal-cutting saws, and Peerless power hacksaw blades.

Medart Patent Pulley Co., Inc., Potomac and DeKalb Sts., St. Louis, Mo., is distributing to those interested in the product of the company, a monthly publication known as "The Dart," which will contain material relating to Medart pulleys and power transmission machinery. The first number, published in June, contains an article on the production of commercial shafting by the use of the Medart shaft turning machines and automatic straightening and polishing machines.

Grand Rapids Grinding Machine Co., Grand Rapids, Mich., has published a book known as the "Grand Rapids Grinder Book," containing a discussion of the subject of drill grinding, and a detailed description of the constructural features of this company's drill grinders, cutter and tool grinders, and tap grinders. Illustrations and specifications of the different styles of machines are also presented. The book includes general information regarding the care and use of twist drills and the grinding of taps.

Vanadium Corporation of America, 120 Broadway, New York City. Booklet entitled "Vanadium (the Master Alloy) in War and Peace," containing description and illustrations showing a large number of applications of vanadium steel in airplanes, locomotives, automobiles, and trucks, for crankshafts, steel springs, piston-rods, tool steel, steel forgings or castings subjected to high stresses, etc. An alphabetical list of some of the principal applications of vanadium steel is included on the last two pages of the book.

General Electric Co., Schenectady, N. Y. Bulletin 42019, descriptive of Curtis steam turbines for mechanical drive, such as the driving of circulating and boiler feed pumps, centrifugal pumps, fans, blowers, etc. A description of the principle involved in these turbines, and a summary of the different parts are presented. Bulletin 41311 A, treating of General Electric 60-cycle synchronous condensers for power-factor control. Calculations necessary in figuring on a synchronous condenser installation, a wiring diagram, and illustrations of actual installations are included.

Brown & Sharpe Mfg. Co., Providence, R. I. Catalogue 28, containing 375 pages, 5 by 7¼ inches, covering the Brown & Sharpe line of small tools. The catalogue describes over 1000 different machinists' tools. In addition to data on the various classes of tools, considerable general information and a large amount of tabular matter of practical use to the shop man are included. Among the tables presented are sizes of numbers of the U. S. standard gage for sheet and plate iron and steel, decimal equivalents of screw gage and of twist drill and steel wire gage, standards for wire gages, tap drill sizes for U. S. standard threads, cutting speeds for milling cutters, data for selecting cutters for bevel gears, etc. A revised price list for this catalogue has also been issued.

Carborundum Co., Niagara Falls, N. Y. Catalogue 6, containing 224 pages devoted to carborundum and aloxite wheels for all classes of grinding, and other products manufactured by this company for use in the metal-working fields. A brief outline of the history of the company and its various branches is given, which is followed by a description of carborundum, its characteristics and uses, as well as the characteristics and uses of aloxite. A description is also included of the manufacture of carborundum and aloxite wheels, illustrated with views showing the different steps in the process. Further material presented includes characteristics of grinding wheels, testing of grinding wheels, selecting wheels of proper grit and grade, protective devices, mounting of grinding wheels, and various rules and tabular material covering speed of wheels, diameters of pulleys, and related matters. A large part of the book is taken up with tables of prices for grinding wheels for use on various types of machines.

TRADE NOTES

Smith, McCrory & Co., Inc., announce the opening of advertising agency offices at 468 College Ave., Racine, Wis.

New Departure Mfg. Co., Bristol, Conn., moved the Chicago sales offices of the company on June 1 from 2721 S. Michigan Ave. to the People's Gas Bldg., at 122 S. Michigan Ave.

Standard Pressed Steel Co., manufacturer of "Standco" hollow set-screws, steel shaft hangers, milled cap-screws, etc., has moved its plant from Philadelphia to new quarters at Jenkintown, Pa.

Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn., announces that it has made sales connections with the Mayhew Steel Products Corporation, 291 Broadway, New York City, to handle the entire output of its factory.

Atlas Die Casting Co., Inc., has been organized at 41 Jackson St., Boston, Mass., with a capitalization of $200,000. The company will employ about 300 men when operating at full capacity. The president of the concern is Arthur M. Brewster, and the treasurer, Malcolm F. MacNeil.

A. H. Petersen Mfg. Co., Milwaukee, Wis., which has been engaged in the manufacture of tools and dies on a large scale for a number of years, has discontinued its tool and die business, and will devote its entire plant to the manufacture of "Hole Shooter" portable electric drills and other automotive devices.

Surface Combustion Co., 366 Gerard Ave., Bronx, New York City, announces that the Franklin Institute of the state of Pennsylvania, acting through its committee on science and the arts, after an investigation of the jet entraining apparatus made by this company, has awarded to the inventor, W. Barton Eddison, the Edward Longstreth medal of merit.

Geometric Tool Co., New Haven, Conn., manufacturer of special machinery and tools for cutting screw threads, has taken over the exclusive sale of the products manufactured by the Charles L. Jarvis Co. of Gildersleeve, Conn. This company's line consists of Jarvis high-speed tapping devices, quick-change chucks and collets, and combination tapping devices equipped with quick-change chucks.

Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill., manufacturer of Woodstock safety tapping chucks, has recently completed four new buildings of two- and three-story brick construction, including a new office building. Part of the factory will be used by the American Ironing Machine Co., manufacturer of mangles, extractors, etc., this company being owned by the Peter Bros. Mfg. Co.

Davis-Bournonville Co., Jersey City, N. J., announces that G. E. Price, Jr., purchasing agent, has resigned to fill a similar position in the Middle West. Owing to present business conditions the company has decided that the position of purchasing agent will not be filled at this time. Purchases will be made under the supervision of the works manager's office, and H. H. Meixsell will have direct supervision of purchases for the present.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., manufacturer of portable electric tools, electric air compressors, and special machinery, announces that the company has informed all the dealers handling its line that it will guarantee present prices for the remainder of the year. The Black & Decker Mfg. Co. states that it is able to do this because in the last seven years (since 1914) the total increase in the prices of its products has been only 38 per cent.

Herberts Machinery & Supply Co., Los Angeles, Cal., has leased a building at 403 East 3rd St., next to the one which the company now occupies. The additional floor space of 11,000 square feet afforded by the new building is required to care for the present business. This company recently sold fifty-eight heavy-duty Monarch lathes and ten Rockford lathes to the Clark-Turner Piston Co. of Los Angeles; this is believed to be the largest lathe order ever placed on the Pacific coast.

Terminal Engineering Co., Inc., 17 W. 44th St., New York City, manufacturer of "Tec" trucks and material handling machinery, announces the following changes in its organization: J. F. McGonigal, formerly with the Foamite Co., and J. H. Potter, mechanical engineer, have been added to the force. E. Lyle, for many years with the Columbia Graphophone Co., has been elected vice-president and is directly responsible for new business. E. Peck has been elected secretary and assistant treasurer.

Stein & Ellbogen Co., 31 N. State St., Chicago, Ill., announces that they have taken over the line of time- and motion-study watches and other instruments of precision formerly handled by Mortimer J. Silberberg, of Chicago. Among the instruments that will be handled are the so-called "split second" time-study watch, which has a double hand, and in addition to other features, permits the taking of observations on two totally different operations at the same time, or the taking of observations on two closely related operations, differing from each other.

Buffalo Forge Co., Buffalo, N. Y., is remodeling its entire fan shop. The new shop will cover 64,235 square feet, including 23,873 square feet of assembling galleries. The reconstruction work is being carried on without interfering with the regular fan construction. The entire machine equipment has been laid out so that all fan construction will proceed with a minimum of handling. The material racks are served by an electric railway truck with an automatic lift platform that permits sheets to be slid directly from the racks to the car and then run into position for the first machining operation.

Clark-Turner Piston Co., 1246 S. Los Angeles St., Los Angeles, Cal., manufacturer of the "Deluxe" light weight gray iron pistons, has recently moved the major portion of its machine shop into a new building several miles distant, the removal being accomplished without interfering with production. The rapid growth of the company, which was started less than two years ago, has necessitated the acquiring of additional space and the concentration of the plant in one locality. This company has appointed the Laystall Motor Engineering Works, Ltd., of London, England, as distributors of "Deluxe" pistons for Great Britain and Ireland.

George Schow Trading Corporation, 123 W. Madison St., Chicago, Ill., has been organized to carry on a general export and import business with all countries and to act as export representative for American manufacturers. The company will also serve as sole American agent for foreign manufacturers and exporters as well as purchasing agent for foreign accounts. Through its agents and representatives abroad, this concern has facilities for exhibiting the goods of American manufacturers. The service rendered includes publicity, selling service, creation of new markets, and appointing of agents and dealers.

Meldrum-Gabrielson Corporation of Syracuse, N. Y., has acquired a factory site at West Fayette and Niagara Sts., on which it will erect a $300,000 plant during the summer. It is planned to have the new plant in operation by November 1. The first building to be erected will be a steel, brick, and concrete structure, two stories high, in which the offices will be located. This company now occupies all the first two floors of the Brayton Industrial Building, in N. Franklin St., where it has extensive equipment for manufacturing special machinery and tools, one of its products being the Syracuse adjustable snap gage.

Simmons Method-Hob Co., Second St. and Duncannon Ave., Olney, Philadelphia, Pa., was recently incorporated under the laws of Pennsylvania for the manufacture of gear-cutting hobs and cutters by a generating process known as the Simmons method. The officers are as follows: Joseph M. Hottel, president and treasurer; I. Powell Thomas, secretary; and O. G. Simmons, vice-president and general manager. The plant is fully equipped, and hobs are now being delivered. The equipment consists of standard precision machine tools and several special generating machines, as well as a heat-treating and hardening department.

Reliable Tool Co., Irvington, N. J., is moving from 33 Ellis Ave., to its new plant at Coit St. and Ney Ave. This plant was constructed especially to meet the requirements of the company, and was designed to accommodate not over one hundred toolmakers, with a view to continuing this concern's policy of maintaining a personally conducted tool shop. The shop proper is on the ground floor, and is 55 by 90 feet. The office is on the second floor at the front of the building and is 55 by 20 feet; this includes a general office and drafting-room. On the main floor are located the wash-room, hardening room, and tool-crib. Considerable new machinery has been installed.

McDonough Mfg. Co., Eau Claire, Wis., announces that after a strike lasting for nearly eight months, the union machinists, helpers, and blacksmiths of the company voluntarily called off the strike and offered to return to work on an open-shop basis. The plant is now operating as an open shop, and will continue on this basis in the future. After being closed for nearly two months, the factory was reopened with non-union men, these men soon being joined by a number of the former employes who had previously belonged to the union. During the strike, production was maintained without interruption, although the plant was picketed for more than eight months.

Canton Foundry & Machine Co., Canton, Ohio, has moved its New York sales exhibition office from the Grand Central Palace to the Manufacturers' Exhibition Co.'s building at 45 W. 18th St., New York City. The company's complete line of machinery, comprising portable cranes, alligator shears, turntables, etc., is on display in the new headquarters. Owing to the fact that the International Purchasing Bureau has been acting exclusively for the last few years as the export division of this company, it has been decided, in order to give better service, to have the export division closely associated with the New York permanent exhibit sales office, and from now on these two concerns will work in conjunction with each other at the new offices.

Greenfield Tap & Die Corporation, Greenfield, Mass., announces that at a meeting of the board of directors in June it was voted to purchase the entire capital stock of the **Greenfield Machine Co.**, manufacturer of cylindrical and universal grinders, and of the **Morgan Grinder Co.**, Worcester, Mass., manufacturer of internal grinders. The products of the Morgan Grinder Co. and the Greenfield Machine Co., together with the machines now produced by the Greenfield Tap & Die Corporation, will constitute the Machine Division of the Greenfield Tap & Die Corporation. The latter company will operate both plants in their present location, although it is the intention to eventually move the Worcester plant to Greenfield. The organization of both plants remains the same as heretofore, the officers of the Morgan Grinder Co. being Ralph L. Morgan, president; L. M. Crittsinger, treasurer; and Charles E. Hildreth, general manager. The officers of the Greenfield Machine Co. are E. F. Smith, president, and Joseph G. Stevens, treasurer.